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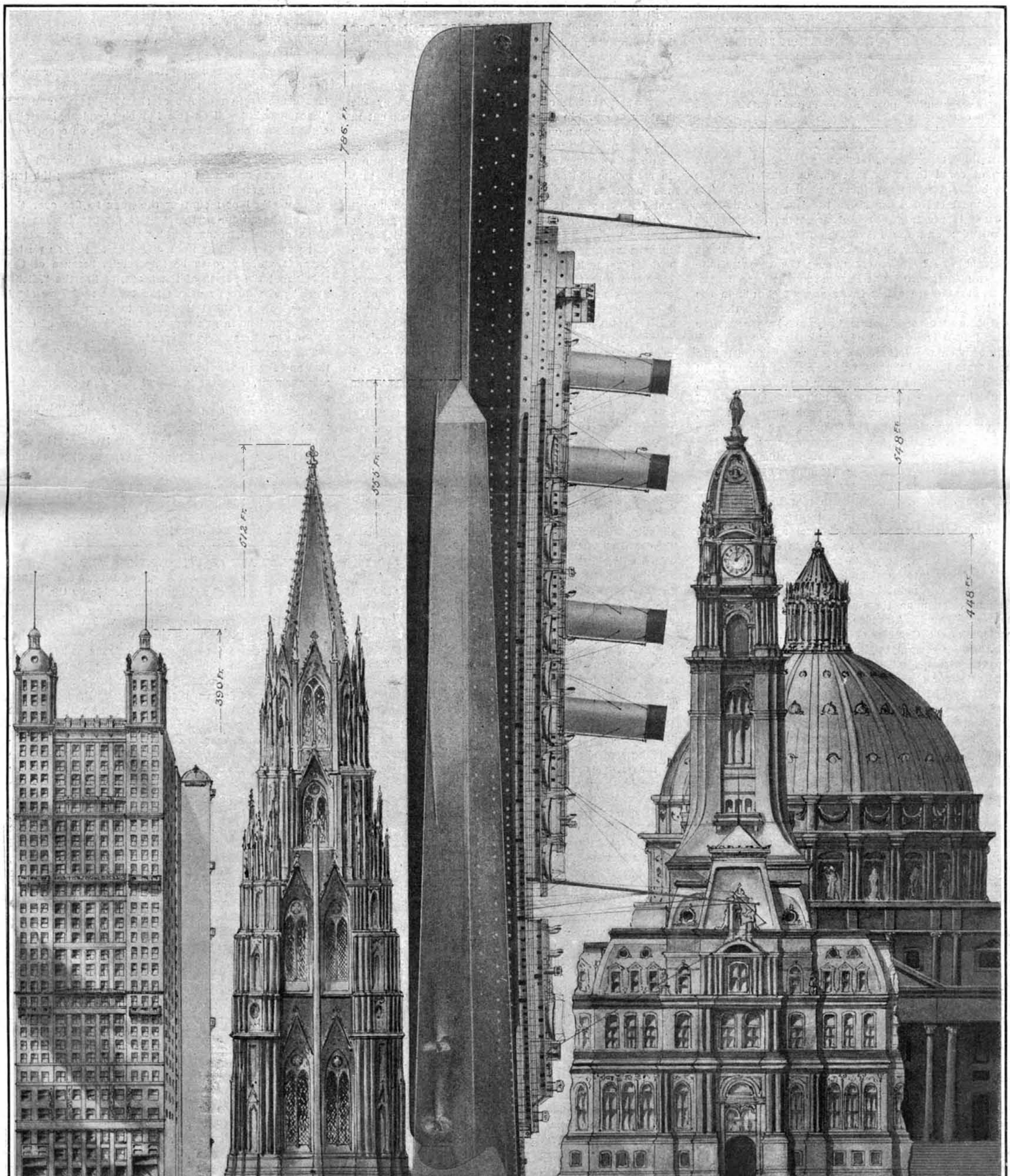

Park Row Building, New York. One of the Spires of Cologne Cathedral. Washington Monument. City Hall, Philadelphia. St. Peter's, Rome.

NEW CUNARD 25-KNOT LINERS COMPARED WITH THE TALLEST BUILDINGS OF THE WORLD.—[See page 270.]

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ESTABLISHED 1845

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NEW YORK, SATURDAY, MARCH 31, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

EARTHQUAKES AND DAM CONSTRUCTION AT PANAMA.

An important question affecting the choice of the type of canal to be built at Panama is that of the possibility of seismic disturbances and their probable effect upon the canal. Unlike the Nicaragua district, Panama is practically free from earthquakes of any magnitude; and the indications are that this comparative immunity has existed for a long period. The fact was brought out during the recent examination into conditions at Panama by the Senate Committee, that there exists in an ancient church in the canal zone, a masonry arch, which is so flat that by all the laws of equilibrium it should long ago have fallen in. It is an object of great curiosity among our engineers on the isthmus, one of whom admitted in the Senate inquiry that he was at a loss to understand how a structure, so evidently near the breaking point, should have maintained its stability for hundreds of years. Now this engineering phenomenon is taken, and very properly so, as giving unmistakable evidence that for several centuries Panama must have been free from those more serious seismic convulsions which have wrought such havoc with structures of every kind in other countries of Central America.

At the same time, it is known that Panama is not altogether free from earthquake tremors, and in making our choice between a high-level and a sea-level canal, the possible destructive effects of earthquake disturbances upon the dams and locks of either type must be taken into consideration. Unquestionably the most vulnerable point in either type of canal will be the dams, for upon them will the very existence of the canal depend. A sea-level canal would involve the construction at Gamboa of a masonry dam 185 feet high, besides several smaller dams to control the flow of small streams tributary to the Chagres. A lock canal calls for the construction at Gatun of an earth dam 135 feet high. The masonry dam at Gamboa will consist of a solid wall carried down everywhere to rock foundation and varying in thickness from 100 feet at the base to 30 feet at the water level. The earth dam at Gatun will consist of a mass of closely-compacted sand and clay, 2,500 feet thick at the base, and 375 feet thick at the water level. As far as we know, there are no actual data to go upon in considering the question of the relative effects of an earthquake upon masonry and earth dams; but it is surely reasonable to expect that under the tremor of an earthquake the lofty, comparatively thin, and unyielding masonry wall of the Gamboa dam would be more likely to rupture than would the broad and more or less elastic mass of the Gatun earth dam; particularly when we remember that the masonry wall will be practically dry throughout its whole mass, while the earth dam will be more or less saturated and plastic. Furthermore, a crack in a dry 50-foot masonry wall would be more likely to extend entirely through the mass than it would if it occurred in a great earthen mound, whose average thickness was over a thousand feet.

We are free to admit that when this question is considered in its bearing on the masonry locks, the advantage lies with the sea-level canal, which has but one of these. At the same time, a crack through the walls of a lock chamber would not be comparable in the extent of the delay, or the possibility of disaster, to a fracture of the great dam at Gamboa. Failure of that dam would mean the wrecking of the whole canal; but the failure of a lock chamber would not necessarily mean even an interruption of navigation. For the locks will be built in duplicate, side by side; and, unless the damage extended entirely across the whole system, ships could pass through the uninjured lock while the damage was being repaired. Even if the damage extended entirely across both flights of locks, it is not likely that the whole of the summit water supply would be lost, as it would be were the Gamboa dam destroyed; for the lock gates would serve to hold back the impounded waters until repairs had been made, and the repairs would not involve anything more serious than grouting out the crack with cement.

However, in any discussion of the earthquake problem at Panama, we must be guided by probabilities, and these indicate that the risk from earthquakes is extremely slight, if, indeed, it may be said to exist at all. Were the canal zone known to be liable to the severe visitations which work such havoc in Central American countries, the United States might just as well give up all idea of a canal at once; for earthquakes of any intensity would undoubtedly wreck the whole enterprise, whether high level or sea level, with locks or without.

A QUART MEASURE IN A PINT POT.

In the matter of the design of the new 16,000-ton battleships "Michigan" and "South Carolina," our Navy Department is just now trying to solve the problem of putting a quart measure into a pint pot. To be more particular, they are trying to prove that 18,500 tons of displacement efficiency can be put into 16,000 tons. But that it cannot be done is proved by the history of warship design, not only in our own but in every important navy of the world.

We do not hesitate to make the statement that there is no art to compare with that of naval architecture, in respect to the amount of "brains and money" that has been devoted to its development. The reason is not far to seek. It has long been understood by all maritime countries in general, and by the greatest maritime country in particular, that the security of a modern nation, if not its very existence, may ultimately depend upon the efficiency of the navy. Consequently the best talent has been sought for the designing and construction of warships; lavish funds have been provided for experimental investigation; and a most careful and jealous watch has been kept by each navy upon the general progress of the art the world over, its results classified, and when they were approved, adopted. It has followed that warship design is the most cosmopolitan and one of the most exact arts of the present day. Out of the maze of theorizing and costly experimentation of the past thirty years, naval architecture has emerged with certain fundamental and firmly established facts and principles of universal acceptance.

The most important fact that has been thus determined is that displacement is the true test (provided there are no glaring errors of design) of a warship's efficiency; that is to say, the bigger ship will be the better ship. The displacement, or total weight of a ship, is the naval architect's working capital, and he will invest it according to his judgment as to where and in what relative quantities it will make the best returns. Thus in the design of the 16,000-ton battleship "Louisiana," the naval constructor allotted 1,500 tons to the guns and ammunition, 4,000 tons to armor, 1,600 tons to motive power, 900 tons to coal, and 7,000 tons to the hull and accessories. Now, it is evident that these proportions might be varied indefinitely, by taking from one allotment and adding to another. Thus, 1,000 tons might be transferred from armor to motive power so as to raise the speed from 18 to 20 knots, or the 1,000 tons might be taken from the hull by using lighter scantling and shaving down slightly on the thickness of shell plating. The final result, however, if the changes were made within reasonable limits, would be the same as far as the total efficiency of the ship was concerned, and the total efficiency would be exactly measurable in terms of the total displacement.

The first duty of a ship is to carry guns and fight them, and naturally the naval architect has exercised his ingenuity in devising means to increase total fire in any given direction without increasing the number of guns carried—in other words, to secure the largest possible arc of fire for each gun. The most serious limitation upon all-round fire is found in the necessity of avoiding "blast interference," that is to say, the harming or hindering of the crew of one gun by the gases from another gun. Our own naval architects made a bold departure in the "Oregon" battleships, in seeking to increase all-round fire by placing the 8-inch guns at a higher level than the 13-inch, and permitting the former to fire across the 13-inch gun turrets. The theory was ingenious and promised flattering results. Yet, when the guns were tried, it was found that the blast from the 8-inch guns, when fired ahead, rendered the sighting hoods of the 13-inch turrets untenable, and stops had to be placed to prevent the 8-inch guns from firing closer than within 13 degrees of the longitudinal axis of the ship. Theoretically, the "Oregon" was more powerfully armed than some foreign ships of 50 per cent more displacement. But when fully loaded her armor belt was nearly submerged; her freeboard was too low to render her fightable in heavy weather; her speed was low, and her coal supply limited. Were she strengthened by the reinforcement of her mountings; were another deck added to her height; another two knots to her speed, and her coal supplies and stores increased by 70 per cent, her displacement would go up from 10,200, to its proper legitimate figure for such an armament, of about 13,000 tons. In a properly designed ship increased displacement always means increased efficiency; conversely, increased efficiency means increased displacement.

Now, in the 16,000-ton, 18-knot battleships, it is claimed that we shall possess ships which are fully the equal of the 18,500-ton, 21-knot "Dreadnought." Our proposed ships are to carry eight 12-inch guns, the foreign ship ten; and the equality of armament is claimed on the ground that, by placing two of the pairs of 12-inch guns at a higher level so that they can fire across the roof of the turrets of the other two pairs, none of the guns will be masked by each other's fire, and an all-round arc of fire will be obtained. In other words, it is proposed to do with the 12-inch guns what was found impossible to do with the 8-inch guns, and fire them across an adjacent turret without hurt or inconvenience to those inside. We think it is extremely improbable that the guns will in practice ever be so fired; in which case the comparative concentration of fire of the "Michigan" and the "Dreadnought" will be two 12-inch ahead against six; eight 12-inch on each beam against eight on each beam with two guns in reserve, sheltered by the turret on the broadside engaged for the time being; and two 12-inch guns astern for each ship, thus giving the ten-gun ship a great superiority of fire.

The method of mounting the guns to fire over the roof of the adjoining turrets was discussed when the plans of the "Dreadnought" were under preparation, and was dismissed as impracticable; and if, as we believe, it will prove to be impossible, because of the shock and the fumes of the gases, to fire the "Michigan's" guns directly across the turret roofs, we shall find ourselves behind the ships that are building by foreign nations in gun power, and behind one of them at least by three knots in speed.

The greatest credit is due to the Bureau of Construction and Repair for the ingenuity of its proposed turret arrangement, and the skill with which constructive problems have been overcome; but with the experience of the "Oregon" and the later double-deck turret craze as object lessons, we believe that the better plan is to increase displacement so as to admit of at least 19 knots speed, with a battery of ten guns so disposed that there can be no interference.

If our experience has taught us one thing above all others in the past, it is that there is no short cut to battleship fighting power; which can be reached only by the broad road of liberal displacement.

WHAT ARE ATOMS, ELECTRONS, AND IONS?

The phenomena of the Crookes tube, of Roentgen rays, and latterly of radium, inexplicable by the chemical theories of a decade ago, have rendered necessary the coining of several new words, which have taken their place in the vocabulary of the modern physicist. We hear so much these days of electrons and ions and their relation to the old-time supposedly indivisible atom that the time seems ripe for a few simple definitions condensed from a recent paper by Prof. Soddy.

The first and oldest conception of the ultimate unit of matter is the *atom*, the smallest particle of an element capable of separate existence. The essential feature of Dalton's conception was that the atoms of the same element are all exactly alike in mass and every other property, but are recognizably different from the atoms of any other kind of element. The statement will be found in text-books of chemistry written long before the recent discoveries were foreshadowed, that if it is ever found possible to transmute any one kind of atom, that is, any one kind of elementary matter, into any other kind, there is little doubt that the same means would be sufficient to transmute or decompose the other elements.

The modern conception of the ultimate unit is the *electron*, and this, although by origin an electrical conception, is in reality a material conception no less than the atom of matter. The electron could be defined as the smallest existence known capable of isolation and of free movement through space. It is a definite amount of "charge" of negative electricity, in a word, the smallest possible amount known to exist; for electricity, no less than matter, has been shown to consist of discrete particles or units, and not to occupy space continuously. Unlike the atoms of matter, only one kind of electron is known, consisting of the same amount or charge of negative electricity with identical properties in all its various manifestations.

It is certain that each atom of matter contains in the normal condition at least one electron, which it is capable of losing, and conversely that it may unite with at least one electron more than it normally possesses without deep-seated material change. An atom with one or more electrons less than it possesses in the normal state is positively charged and is often called a *positive ion*. Similarly an atom with one or more electrons in excess is a *negative ion*.

THE HEAVENS IN APRIL, 1906.

BY HENRY NORRIS RUSSELL, PH.D.

The star-map which accompanies this article was first published in this magazine just twenty years ago. But it is quite as useful now as it was then, for the aspect of the heavens has not changed enough in the interval to alter the place of any star on the map by as much as 1-200 of an inch. It represents the sky as it would be seen by an observer lying flat on his back with his feet toward the south and looking directly upward. This is hardly a convenient position, and for practical purposes it is best to hold the map vertical, and turn it so that the part of the margin which corresponds to the direction in which one is looking is at the bottom. It will then be a very easy matter to identify all the more conspicuous stars.

For example, if we face due west we will see Orion almost in front of us, low down near the horizon. To the right will be Taurus (the Bull) with the bright Aldebaran and the Pleiades and the still brighter planet Jupiter between them. On the opposite side of Orion is the Great Dog, Canis Major, with Sirius (denoted on the map by the Greek letter α, which is given it because it is the brightest star in the constellation). Above all these the Milky Way forms a great arch along the western sky. Following it from south to north we find first a few stars of the southern constellation Argo; then, after a blank space, the Little Dog, with Procyon; then Gemini, the Twins; then Auriga, the Charioteer; then Perseus, and finally the zig-zag line of Cassepeia.

Turning our map now so that the south is at the bottom, we may identify Leo, high overhead; then Cancer, the Crab, to the right, with the fuzzy star cluster known as the Beehive (*Præsepe* in Latin). Below this is the head of the sea-serpent Hydra, whose ungainly length stretches far to the southeast, including many faint stars not shown on the map. On the back of Hydra stand the inconspicuous group of Crater, the Cup, and the more prominent one of Corvus, the crow.

The constellation of the Virgin is well visible in the southeast and to the left of it is the Herdsman (Boötes). The star α in this constellation is Arcturus, one of the brightest in the sky. Below this is the semi-circle of the Northern Crown and parts of Hercules and of Serpens, which are still rising.

North of the zenith is the Great Bear, now admirably displayed. The Dipper can be easily identified on the map. Its two brightest stars, α and β, point toward the Pole, as is shown by the arrow. The Little Bear lies to the right of the Pole, and Draco, the Dragon, enfolds it in his coils. Cepheus, one of the less prominent of the circumpolar constellations, lies below the Pole, but he is brilliant compared with Camelopard, a modern constellation invented to fill the great blank between Casseopeia and the Great Bear.

THE PLANETS.

Mercury is nominally evening star until the 4th and morning star after that date, but he is too near the sun to be seen until the latter part of the month, when he rises at about 4:30 A. M. and is visible before sunrise.

Venus is evening star and is once more becoming prominent in our evening skies. At the beginning of the month she is in Pisces and sets only about an hour later than the sun, but as the weeks go on she moves through Aries into Taurus and becomes steadily more conspicuous till at the end of the month she remains in sight until after 8 P. M.

Mars is also an evening star in Aries and Taurus, setting a little before 9 o'clock in the middle of the month. He is a long way from the Earth—about 220 million miles—but he still sends us as much light as a pretty bright star.

Jupiter is evening star, in Taurus, not far from Mars and Venus, which are rapidly overtaking him. On the 1st he remains in sight until 10:30 P. M., but on the 30th he sets a little after 9 o'clock.

Saturn is morning star in Aquarius, rising at 4 A. M. in the middle of the month. Uranus is in Sagittarius, and comes to the meridian about 5 A. M. on the 15th. Neptune is in Gemini and sets at about 8 P. M.

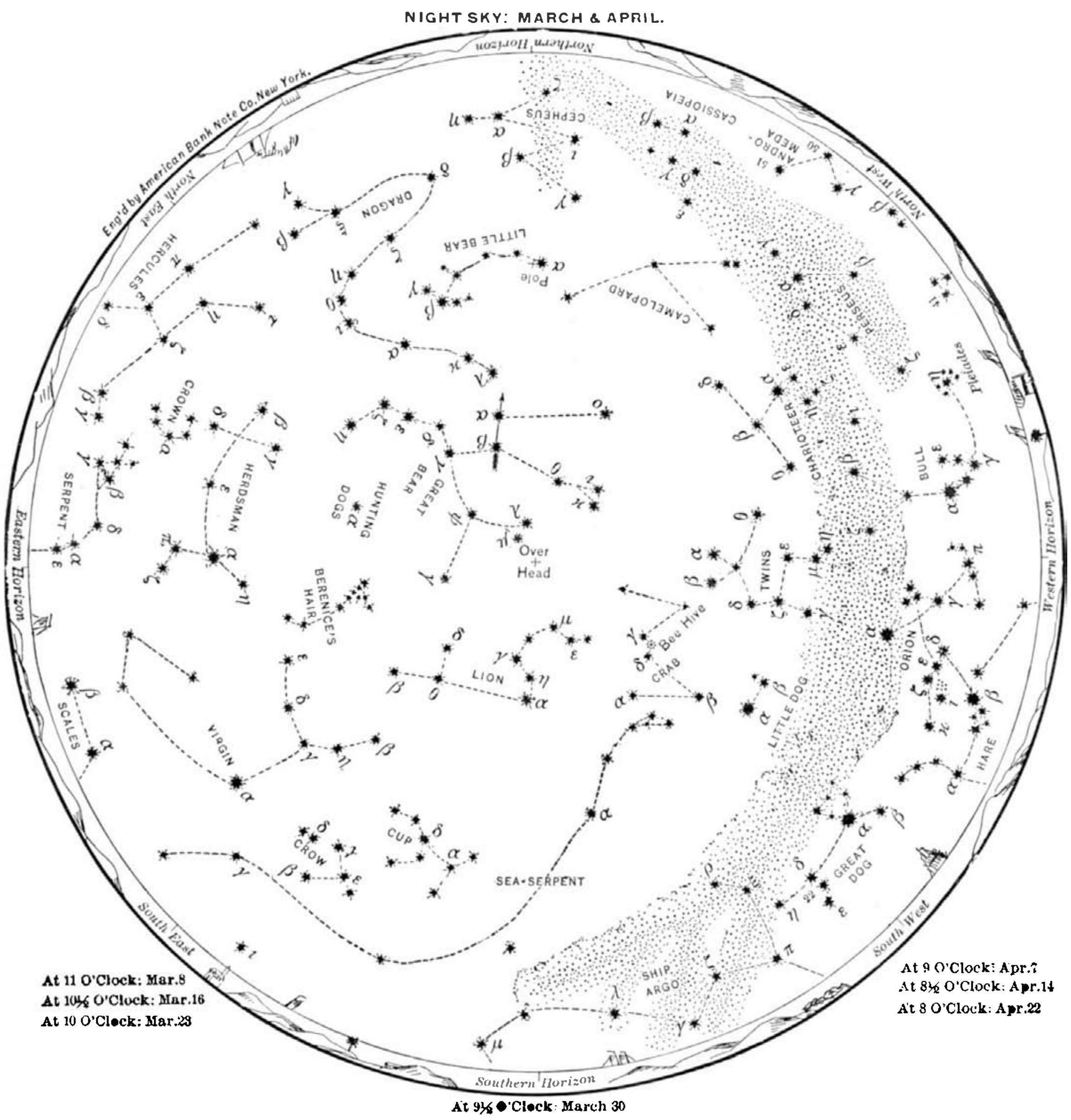
THE MOON.

First quarter occurs at 11 P. M. on the 1st, full moon at 1 A. M. on the 9th, last quarter at 3 P. M. on the 15th, and new moon at 11 A. M. on the 23d. The moon is nearest us on the 10th and farthest away on the 25th. She is in conjunction with Neptune on the 1st, Uranus on the 14th, Saturn on the 19th (when an occultation is visible in South America), Mercury on the 21st, Venus on the 24th, Mars on the 25th, Jupiter on the 26th, and Neptune again on the 28th.

A faint comet was discovered photographically by Kopff, of Heidelberg, on March 3. Calculation of its orbit shows that it is already moving away from the sun and from the earth, and that it will rapidly grow fainter and soon disappear.

Giacobini's comet and Brook's comet are also still in sight, but they are both growing fainter and are only of interest to telescopic observers. There is no other astronomical news of much interest.

Princeton, March 12, 1906.



In the map, stars of the first magnitude are eight-pointed; second magnitude, six-pointed; third magnitude, five-pointed; fourth magnitude (a few), four-pointed; fifth magnitude (very few), three-pointed; counting the points only as shown in the solid outline, without the intermediate lines signifying star rays.

PROPOSED BILL FOR THE EXTENSION OF PATENTS.

A bill which provides for the extension of patents has been introduced in both the House and the Senate through the efforts of the American Bar Association.

As most patent attorneys know, the Act of 1836 contained in one of its sections a provision for the extension of patents. During the twenty-five years of its life this provision afforded protection to many meritorious inventors who had failed to obtain a suitable reward from their invention during the terms of their patents. For some unknown reason this particular section providing for the extension of patents was repealed in 1861.

In the opinion of the American Bar Association's committee on patent, trade mark, and copyright law, a law permitting extension is an important requisite of our patent system. It is claimed that inventors are, as a class, in advance of their age. They enter a field already occupied by old devices, which in most cases must be displaced before the new invention can be introduced. This is a work of time, during which the patent is running. When the public has finally come to realize the value of the invention, the patent is often ready to expire. Or, if the invention goes sooner into use, the patent is infringed, and litigation must be begun and prosecuted to the end before the inventor can control the use of his invention and realize a profit from it. Sometimes infringement suits consume the entire term of seventeen years.

If the bill in question ever becomes a law it is obviously important that it should provide for extensions only in proper cases, and that the rights of the public should be carefully guarded so as to prevent the undue creation of oppressive monopolies. In the opinion of the American Bar Association, an application for an extension should require:

1. Evidence that the patent was valid when granted.
2. That the inventor has, through no fault of his own, reaped but a small reward from the invention, either because he was ahead of his age, or because the patent was infringed and that the litigation in which the validity of the patent was tested consumed many years of its life.
3. That no rights in others have arisen which would make it inequitable to extend the patent.
4. That the public will be benefited by the granting of the extension.
5. Application for extension should be published and everyone having an interest given an opportunity to oppose the extension if there is just cause for doing so. If an opposition is filed and on evidence the commissioner decides that the extension should be allowed or refused, the opponent or the patentee should be permitted to appeal to the Court of Appeals of the District of Columbia in usual course to review the decision of the commissioner.
6. The commissioner of patents should always exercise discretion as to the granting of extension, and should do so only in cases where the proofs conform to the foregoing requirements.

PEOPLE WHO HAVE EATEN BOOKS.

Among the causes that contribute to the destruction of books, says an Italian writer, Americo Scarlatti, there is one very curious one that may be called bibliophagia. No reference is intended to the mice that once destroyed in England an entire edition of Castell's "Lexicon Heptaglotton," but to human beings, who have literally devoured books.

In 1370 Barnabo Visconti compelled two papal delegates to eat the bull of excommunication which they had brought him, together with its silken cords and leaden seal. As the bull was written on parchment, not paper, it was all the more difficult to digest. A similar anecdote was related by Oelrich, in his "Dissertatio de Bibliothecarum et Librorum Fatis" (1756), of an Austrian general, who had signed a note for two thousand florins, and when it fell due, compelled his creditors to eat it. The Tartars, when books fall into their possession, eat them, that they may acquire the knowledge contained in them. A Scandinavian writer, the author of a political book, was compelled to choose between being beheaded or eating his manuscript boiled in broth. Isaac Volmar, who wrote some spicy satires against Bernard, Duke of Saxony, was not allowed the courtesy of the kitchen, but was forced to swallow them uncooked. Still worse was the fate of Philip Oldenburger, a jurist of great renown, who was condemned not only to eat a pamphlet of his writing, but also to be flogged duing his repast, with orders that the flogging should not cease until he had swallowed the last crumb.

The defects in the Italian railway service, instead of decreasing since the railways have been taken over by the State, are becoming more and more intolerable, says the Milan Times. Passenger trains are hours behind their schedule time, and the goods service simply baffles criticism. As an instance, one may state that it is now not an unusual occurrence for truckloads to take a month or more to get from Genoa to their Milan destination. At times the grain service to Switzerland has been practically suspended.

ELECTRICAL MUSIC.

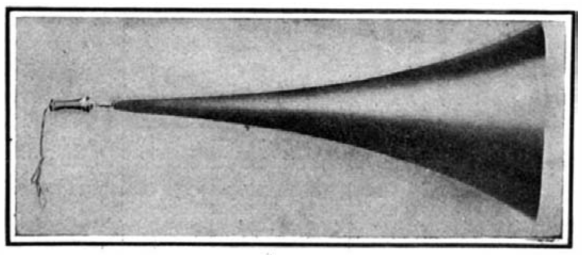
By means of a system proposed by Dr. Thaddeus Cahill, music is generated at a central station in the shape of electrical vibrations and thence distributed by means of wires to a thousand, or several thousand, hotels, clubs, and parlors, in each of which music is heard as if the performers were present in the room. The music is produced at a central station entirely by means of electrical apparatus, and without the intervention of pipe, reed, or string. And it may be heard wherever a wire can be run. The music rendered in hotel or parlor is not the whisper of the telephone nor the characteristic sound of the graphophone or phonograph, but pure, clear notes and chords, as loud as if an orchestra were on the spot.

Objectively, sound is merely a vibration of the air, and it has long been known to scientists that there is a definite relation between the frequency of vibration and the pitch of the resulting sound or note. It is possible also to produce electrical vibrations that shall correspond in frequency with a given note.

Dr. Cahill, the inventor of electrical music, appears to have combined the principles of acoustics and electricity and so used them as to produce what may be called electrical music. His music-generating system differs from previous means of producing music in that it is purely electrical. Heretofore music has been produced by strings, reeds, pipes, or other tuned sounding bodies, which set the air in vibration. By the Cahill system, however, the music is initiated as electrical vibrations; the expression is controlled by electrical means; it is distributed in the form of electricity, and, finally, is turned into aerial vibrations or audible music on the premises of a thousand different subscribers, and at widely different points—many miles apart, it may be.

A visit to the laboratory and factory of Dr. Cahill in Holyoke, Mass., reveals an elaborate electrical apparatus. He has been engaged in perfecting this apparatus for years, with the assistance of his brothers, Messrs. George Frederick and Arthur T. Cahill, and it seems now to have reached the commercial standpoint. That the installation has long since passed the experimental stage will be appreciated when it is known that there is now in use in the inventor's laboratory at Holyoke a central station plant containing one hundred and forty-five directly-coupled inductor alternators.

These alternators are arranged in eight sections or panels, each inductor being mounted on an eleven-inch steel shaft. The bed plate of the machine is built up of eighteen-inch steel girders, mounted on brick piers, and is more than sixty feet long. The switchboards are in ten sections and contain nearly 2,000 switches. These are controlled from a distant keyboard through electro-magnetic action. There are numerous transformers, one of which is seen in one of the accompanying illustrations, and many rheostats and other regulating devices, including in the aggregate thousands of coils and sections. The whole plant weighs more than 200 tons and has cost approximately $200,000. A second large apparatus is also well under way.



The Electrical Receiver Which Produces the Sound Waves.

The inventor's first complete apparatus, parts of which are shown in the illustrations, was built in Washington some years ago. The larger work has been done at Holyoke, where the Cahill laboratory has been located for the last four years.

It is not possible in the present article to describe the mechanical details embodied in the construction of so large and complicated a mechanism. A mere outline of the general features can be given in one article. The generating set consists of a number of alternating-current generators—one for each note of the musical scale. Each of these generators produces as many electrical vibrations per second as there are aerial vibrations per second in that note of the musical scale for which it stands.

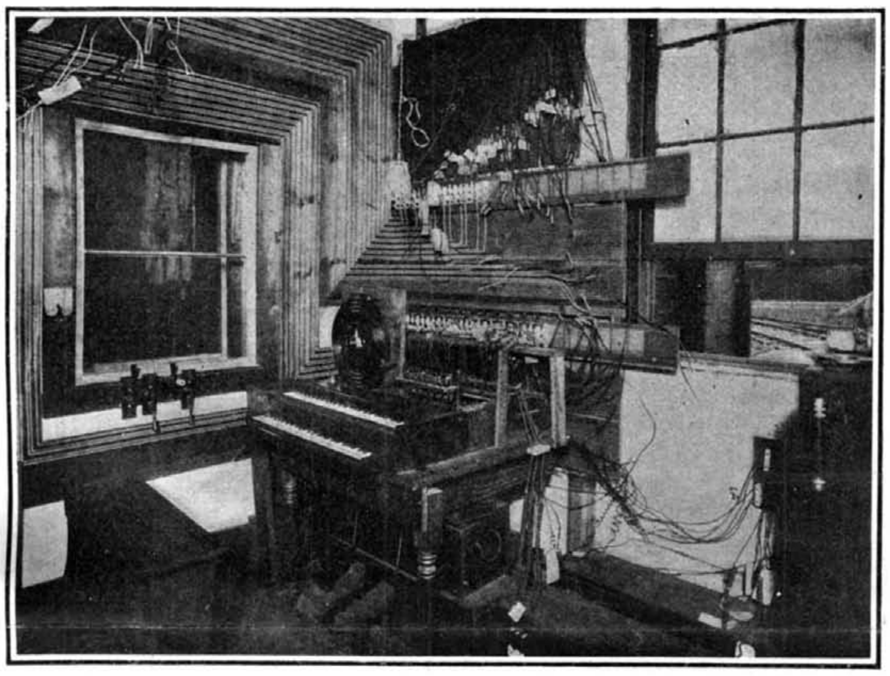
The generators are inductor-alternators and of very simple construction. The fixed or stator part of each carries both the field and the armature windings. The rotors are mounted upon shafts; the shafts are geared together; and the number of teeth or poles in the several rotors and the angular velocities of the shafts are suitably arranged so as to produce the notes of the compass through five octaves. The tuning is remarkably good, and from the nature of things, absolutely unchangeable. It is interesting to note that while in the past it has been very difficult to measure, with scientific accuracy, the energy of any note or sound, the power of these generators can be easily determined with the ordinary electric measuring instruments. Several of the generators for single notes are said to have an output of from 15 to 19 horse-power. When it is remembered that one man can supply energy for a great pipe organ, with its many pipes speaking at once, some idea may be obtained of the number of receiving stations that can be supplied from an apparatus in which a single note has many horse-power behind it.

From the battery of generators one naturally goes next to the keyboards on which the musician plays. These are in a different room from the running parts of the machine so that the player may not be disturbed by the hum of so many generators. From the latter a maze of wires lead through the walls to the keyboards, at which the performer sits.

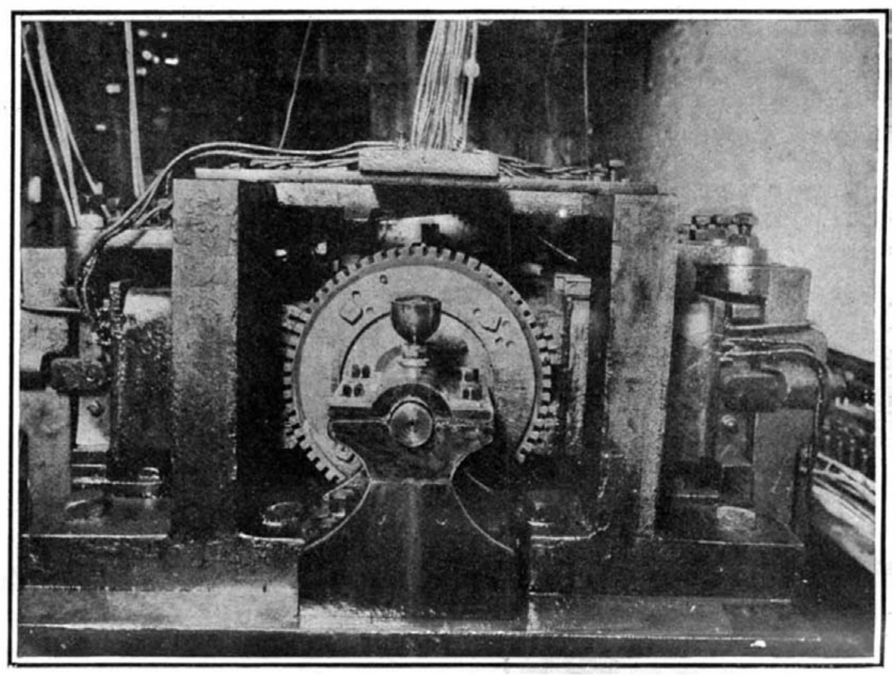
The keys operate electric switches so as to bring the several alternators into action on the lines or mains, as required. Across these lines or mains receiving telephones are connected in parallel, similarly to the way incandescent lamps are wired. With each receiving telephone a large paper horn is used. Thus, the depressing of a key throws upon the line the set of electrical vibrations corresponding with that note of the musical scale for which the key stands, and a loud, clear tone sounds forth from the receiver. The alternators are especially constructed to produce sounds whose purity and musical beauty strike the ear instantly.

In the Cahill music room there are no musical instruments in the sense in which that word has been understood heretofore. There is not a string or reed or sounding pipe in the whole apparatus. The vibrations produced by the performer's playing are wholly electrical, and it is not until such electrical vibrations reach the telephone receiver that any sound is produced. Yet if one had an electrical ear adapted to perceive electrical vibrations as one has an ear of living tissues to catch aerial vibrations, he would hear the music anywhere on the lines or mains without the necessity of a telephone receiver and horn to transform the electrical musical vibrations into audible music.

The electrical music has been sent several times from the laboratory in one part of Holyoke, to the ball-room of the Hotel Hamilton in another part of the city, over ordinary telephone wires. Two receiving telephones in one of the dressing rooms transform the electrical vibrations into aerial vibrations and the whole ball-room is filled as with the strains of an orchestra. In violin and 'cello pieces the listener hears the bow gliding across the strings—or thinks he hears it, for there is in fact neither bow nor string. The whole is purely electrical, yet the ear is almost right in its guess, for though the horsehair bow be absent, the living hand of the performer is controlling what answers to an electrical bow. The performer himself hears only the electrical music. He listens to

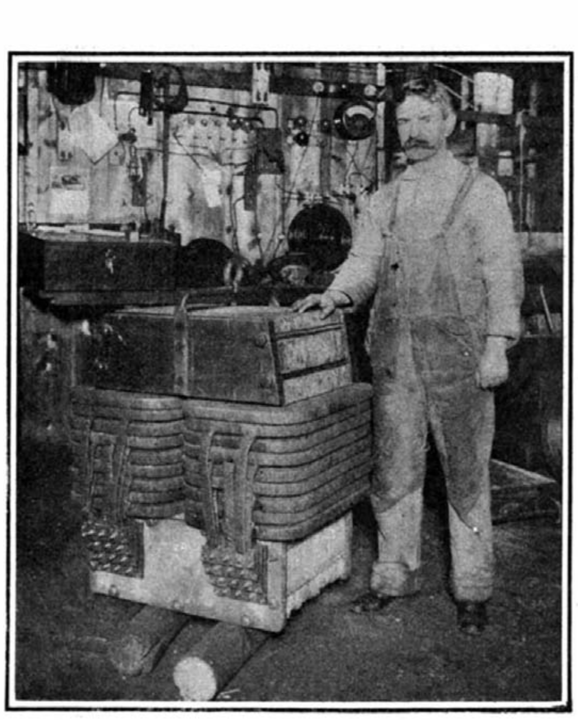


The Electrical Keyboard Upon Which the Musician Plays.

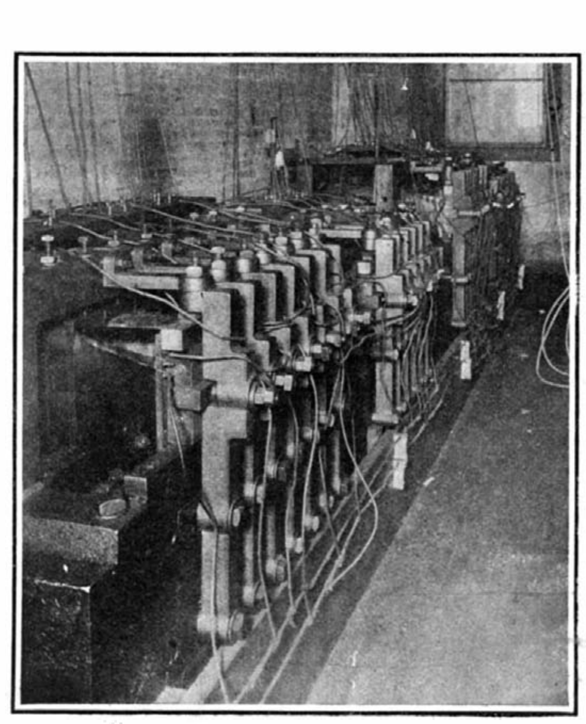


The Rotor of One of the High-Frequency Inductor Alternators.

ELECTRICAL MUSIC.



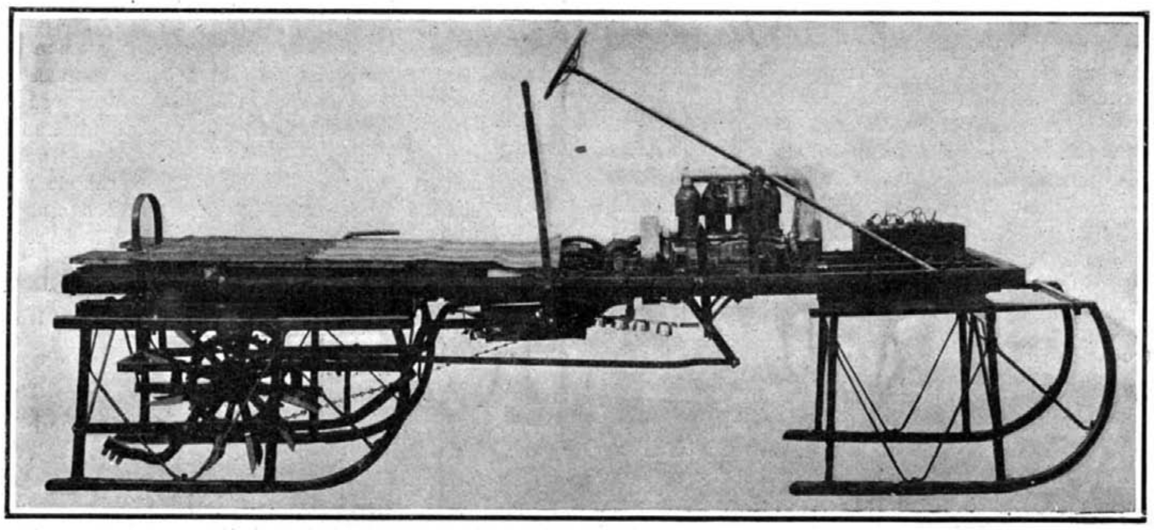
One of the Tone-Mixing Transformers.



A Group of Inductor Alternators.

a receiving instrument just as his hearers do in the next block or miles away.

One of the striking features of the electrical music, as heard in the Cahill laboratory in Holyoke, is the performer's perfect control of the expression. The volume of sound seems to respond absolutely to his touch—in fact, the hearer soon becomes conscious that the soul of the musician is in his music. By the touch of the hand the performer controls the attack and mixing the required harmonics in the required proportions. A musician in Dr. Cahill's laboratory showed a staff correspondent that a mere ground tone produces a clear, pure flute note, a ground tone with the third and fourth harmonics of suitable strength produces the sound of a clarinet, while to imitate the violin all the harmonics up to the eighth were useful. Another combination of harmonics, in which the seventh and eighth are strong, gives the characteristic blare of brass. In addition to reproducing the leading orchestral tones, a skillful performer can mix the harmonics so as to produce musical timbres unknown before. These new qualities are a striking feature of the electrical music.



CHASSIS OF SLEIGH, SHOWING 12-HORSE-POWER, 4-CYLINDER, AIR-COOLED MOTOR CONNECTED THROUGH A CHAIN AND TWO SPEED GEAR TO THE SPIKED DRIVE WHEEL AT THE REAR.

sostenuto and varies the note at every instant. The musicians at the Cahill laboratory produced very good vibrato effects, and crescendos and diminuendos not inferior to those produced by a good violin.

The singularly pure quality of the tones and the remarkable control over them which the performer possesses take the listener by surprise. It is a curious system in which a battery of powerful alternators at a central station may be used to vibrate diaphragms all over a great city, producing music in thousands of homes, while the electrical forces are so perfectly under the control of the performer's fingers that they respond to their musical feelings more perfectly than any existing instrument, saving the violin, viola, and 'cello. It is said to be as easy for a musician to recognize a friend's touch a mile or fifty miles away, as if he were playing a violin in the next room.

Perhaps one of the most remarkable features of this new art is the "tone mixing" or "tone building." Physicists have known for some time that most musical sounds were composed of several parts or elements and that the different tone qualities or tone colors resulted from the presence of different overtones or harmonics in combination with the fundamental or ground tone. Thus, when a single key is struck on the piano, the tone is composed of several different sets of vibrations, from the lowest of which it receives its pitch-designation. This is called the ground tone, fundamental, or first partial, while the other elements are called overtones or harmonics, and it is well known that if the ground tone is represented by n, the overtones for the lower notes of a piano will be $2n$, $3n$, $4n$, $5n$, etc. The timbre or quality of the note, then, depends upon the harmonics which enter into it and their respective strengths. Now, in the musical instruments of the past the tone-color or quality is dependent upon many things. In the piano, for instance, the kind of wire used, the manner in which it was drawn and tempered, the tightness with which it is strung, the manner of attaching to the soundboard, the shape, material, and nature of the soundboard, the weight and hardness of the hammer with which it is struck, the place where it is struck, etc., each plays its part in, and has an effect upon, the sound produced. The same general principle applies to other musical instruments. In Dr. Cahill's electrical music system, however, the different elements of a tone are generated separately and blended at the will of the performer in such combinations as he may desire. A number of inductoriums or tone mixers serve to build up from the simple or sinusoidal waves of the alternators complex resultant vibrations. Thus, several alternators contribute their waves to produce a single note, when that is of a rich or string quality. Several such notes on a single keyboard are combined electrically into more highly composite vibrations, which, when they reach the ear, appeal to it as musical chords of great beauty. In some cases the complex vibrations from different keyboards are further combined into still more highly composite vibrations, so as to produce several voices or parts, as a violin and a 'cello, or a clarinet and flute, in the same receiver at the same instant. Some of these superpositions of vibrations are produced conductively and some magnetically.

This system of building up the quality of tone desired by mixing with the ground tone one or many harmonics, with any strength desired, opens up a new field of timbre control. The wood-wind, brass, and stringed tones of the orchestra are easily produced by

It is impossible within the limits of this article to enter upon any elaborate description of these tone-mixing or tone-building devices. Suffice it to say that there are special forms of inductoriums, having usually a plurality of primary circuits into which vibrations from different alternators are fed, and a combining secondary circuit in which resultant vibrations are produced, equivalent musically and electrically to the several series of vibrations in the several primary circuits. Some of these inductoriums have iron circuits almost closed; others have open iron circuits; while still others are air-core transformers—entirely without iron. One of the illustrations shows a "tone-mixer" in which the electrical vibrations are combined magnetically.

One thing that is to be emphasized in connection with this new music is that while the telephone is employed as a receiver it is not held to the ear. It would be bad for the ear if it were, when a loud note is sounded. The current in the receiver is literally thousands and at times millions of times stronger, measured in watts, than those to which an ordinary telephone receiver responds. Thus, Sir William Preece, superintendent of the British telegraph and telephone system, found that a telephone receiver would respond to a current of six ten-millionths of a millionth (6/10,000,000,000,000) of an ampere, and Continental electricians have found even a weaker current sufficient. In the Cahill system, for loud tones, a current of an ampere is sometimes used for an instant in the receiver.

In consequence, instead of a feeble sound in a telephone held to the ear, feebler often than the slight inductive noises of the line, a musical tone, as loud and clear as it is sweet and pure, fills the whole room, and the inductive noises of the line, which can be heard when a common telephone is pressed to the ear, cannot be discovered even by the closest listening. The sound, on the contrary, is absolutely sweet and pure.

The electrical music is characterized by the following points: Perfect tuning; pure, clear tones that fill the room; qualities so closely resembling the principal orchestral instruments that they would be mistaken for them; new qualities, also, which it is impossible to describe, and which must be heard to be appreciated—a singular attack, which is controlled by the performer's touch, and which seems at one instant to be that of a bow, at another that of a hammer on a string, at another that of a wood-wind, according to the effect which the performer desires to produce on the instrument that he wishes to imitate; and last, and most important, the fact that the music, produced in the form of electrical vibrations, is divisible and distributable and can be produced at a thousand places simultaneously, with as much power in each as if an orchestra were on the spot.

A SIMPLE AND SPEEDY MOTOR SLEIGH.

What appears to be a very promising solution of the motor sleigh problem is a machine of this sort constructed recently by two residents of Springfield, Ohio—Messrs. Temple and Redmond. The inventor of the sleigh appears in the photograph seated in the front on the left. As can be seen from the chassis view, power for driving the sleigh is obtained from a four-cylinder air-cooled motor of about 12 horse-power. The cylinders of this engine are provided with air jackets through which a blower mounted on the crankshaft sends a forced draft for the purpose of keeping them cool. The engine drives a countershaft placed behind it, by means of bevel gears; and pinions on this countershaft mesh with spur gears on a second parallel countershaft. The spur gears may be locked to their shaft by friction clutches, and thus two different speeds are obtained, since the driving sprocket is keyed on this shaft and connected by chain with the snow paddle. This wheel has double rows of strong, sharp, steel blades which successfully grip the snow or cut into the ice beneath. The wheel is spring-pressed against the ground. It can rise 12 inches above its normal level and can drop still further, so that it has a vertical play of something like 2½ feet. The curved bar with teeth on the end, which is seen beside the drive wheel, acts as a brake when pressed against the ground. The long horizontal rod connecting this bar with the brake pedal in front is seen beneath the

MOTOR SLEIGH SAID TO BE CAPABLE OF MAKING 35 MILES AN HOUR ON SNOW AND 90 MILES AN HOUR ON ICE.

sleigh, as is also a string of bells for the purpose of simulating the music of a similar horse-drawn vehicle. The long lever at the side operates the clutches fc. obtaining the different speeds. The sleigh is 14 feet in length and has runners 22 inches high. Its weight is 1,400 pounds. Its inventors claim for it that it has carried twenty people eight miles an hour through the snow. Its normal speed is from 20 to 35 miles an hour over good, well-packed roads, and carrying a load of from four to eight people. On ice, when fitted with a special wheel for speed, it will travel around 90 miles an hour, and the inventors claim that it has pulled two tons at a rate of speed of 36 miles an hour on ice. On account of the light weight and great carrying power, it should be of use at some places in the Arctic regions and in all countries where it is possible to travel many months of the year on snow or ice.

THE NEW CUNARDERS.

The Cunard Steamship Company are building their new twenty-five-knot transatlantic liners with the expressed intention, among other things, of bringing back to that line the "blue ribbon of the Atlantic"; and that they will succeed in doing this is generally considered to be a foregone conclusion. The fastest average time for the eastward passage is 23.58 knots per hour. This record is at present held by the "Kaiser Wilhelm II." of the North German Lloyd line, which ship also holds the distinction of being the longest, broadest, and deepest of the fast transatlantic liners, her length being 706 feet, her beam 72 feet, and her molded depth 52½ feet. Her engines are of something over 40,000 horse-power when working up to their full power, as they did on the occasion when they drove this fine vessel day and night, for the whole eastward passage, at an average speed of 23.58 knots per hour.

The builders of the new Cunarders have guaranteed that they shall maintain an average speed of 24½ knots an hour for the whole transatlantic passage, and in view of the great size of the ships, their exceedingly fine underwater form, their great momentum when under way, and the enormous horse-power which their quadruple turbines will develop, 24½ knots should not only be easy of accomplishment, but should be greatly exceeded, at least on the trial trip. Judging from the fact that recent turbine steamers have invariably exceeded their contract speeds, the new liners should make 25½ knots on trial. It would not be surprising to see them touch the 26-knot mark.

It is difficult to gather from a mere statement of dimensions an adequate idea of such great structures as these new ships will be, and to assist in appreciating their size, we give a comparative table of eight of the largest Atlantic liners of the present day; while on the front page will be found a graphic comparison, in which one of these ships is shown standing on end amid a group of five of the most notable tall buildings in existence.

Referring to the tabular comparison we note that the new ships will be larger on every point of comparison even than the famous old "Great Eastern," whose great depth and beam, even at the present day, exceed that of any ship afloat. Comparing the Cunarders with the largest ships that have yet been built, we

THE BIG STEAMSHIPS OF THE WORLD.

	Length Over All in Feet.	Beam, Feet.	Depth, Feet.	Displacement.	Horse-Power.	Speed.
Great Eastern	692	83	57½	27,000	8,000	14.25
Lucania	625	65	42	19,000	30,000	22.01
Oceanic.	704	68	49	28,500	28,000	19.50
Deutschland......	686	67	42	23,000	37,500	23.51
Baltic..	725	75	49	40,000	18,000	16.25
Kaiser Wilhelm II	706	72	52½	30,000	40,000	23.58
Amerika....... ...	680	74½	53	36,000	15,000	16.00
New Cunarders.	786	88	60	43,000	75,000	25.00

find that they are 61 feet longer than the "Baltic," 13 feet broader, and will have 11 feet more of molded depth; that is to say, their plating will be carried up one deck higher. Yet, in point of dead weight or displacement they will be only 3,000 tons larger than the "Baltic," a fact which shows at once how greatly the under water body of these ships must have been cut away and fined down in order to obtain the easy lines necessary to their great speed. The "Baltic" has maintained 16.25 knots an hour across the Atlantic, when her engines were indicating 18,000 horse-power; but to drive the Cunarders 9 knots faster will require over four times as much power.

Our artist has brought together on the front page of this issue a group of some of the most famous among the loftiest buildings of the world. Of these, the Park Row office building, on lower Broadway, this city, is the smallest; and yet it only lacks 10 feet of being 400 feet in height, the measurement being taken to the top of the cupola above the dome. Fifty-eight feet above this, towers the gilded cross which surmounts the cupola above the gigantic dome of St. Peter's cathedral at Rome; and we cannot refrain from slightly digressing here from our subject to draw particular attention to the vast size of this splendid architectural work of mediæval times. Its great dome has a diameter of 139 feet, and is so vast that it has a clear height from the floor of the church to the highest point of the interior of the dome of 333 feet. This means that if the American Surety Building, which is 82 feet square, and a trifle over 300 feet in height, were stood on the floor of the cathedral and immediately below the center of the dome its cornice, although it would reach 308 feet into the dome, would nowhere touch the ceiling. It is 448 feet from the ground to the top of the cross of St. Peter's. Sixty-four feet higher than that are the finials which surmount the two great western spires of the famous Cologne cathedral. Both of these spires extend 512 feet into the air, and they form one of the most impressive features of this world-renowned Gothic cathedral, which in point of lofty dimensions holds the same pre-eminent position among Gothic cathedrals as St. Peter's does among the great Renaissance cathedrals. The two tallest masonry buildings in the world are to be found in this country, one of these being the tower of the city hall at Philadelphia, and the other the Washington Monument, at Washington, D. C. The top of the hat of the statue of William Penn which crowns the tower of the Philadelphia building is 548 feet above the street level, and 7 feet higher than this is the apex of the pyramidal top of the Washington Monument, whose height above the ground is 555 feet. If one of the new Cunarders were to be stood on end, its bow pointing heavenward and the buildings we have mentioned grouped around it, it would tower 231 feet above the highest of them. Incidentally, our drawing serves to show how big the mass of the ship would bulk even among the colossal structures that are illustrated.

Of these two vessels, the one which is being built at the John Brown Company's works, Clydesdale, is expected to be launched about July next; but it is not likely that she will be ready for her trial trips until the following spring. The other vessel, which is building at Swan & Hunter's yard, on the Tyne, will probably be launched about September next and will be given her trial trip in about a year from that time. As we mentioned in our last issue, it has been proposed by the company to call the first of these ships the "Lusitania" and the other the "Mauritania." The announcement of these names has been received very unfavorably in this country, on the ground that they are cumbersome and have no appropriate importance or significance. The Scientific American has suggested that the company revive those two grand old names "Britannia" and "Hibernia," which were held by the first ships that carried the Cunard flag across the Atlantic.

The Death of Prof. R. Ogden Doremus.

Prof. R. Ogden Doremus died on March 22, at the age of eighty-two. He was one of the best-known American physicists and chemists. After preliminary training at New York and Columbia universities, he became assistant to Dr. John W. Draper in the laboratory of the Medical School. In 1848 he equipped, with Charles Townsend Harris, a laboratory where he lectured to students of the College of Pharmacy, of which he had been elected professor of chemistry. This was probably the first laboratory of its kind founded in America. From 1853 to 1903 he was professor of chemistry and physics of the College of the City of New York. The laboratory which he designed for that institution has been a model for many a college laboratory since established.

In his teaching he was greatly aided by his power of speech. He was popular as a lecturer, illustrating his addresses with experiments. On one occasion at the Academy of Music, in 1855, he took daguerreotypes of all the persons in the boxes by an arc light and exhibited an induction coil with a 6-inch spark, a marvelous achievement in those days.

Dr. Doremus was the first toxicological expert called in New York in a murder trial. For many years he was a well-known expert in litigation involving expert testimony. He was a member of the Medical Advisory Commission of the city, helped to found the municipal Department of Health and Bureau of Chemistry. He introduced the disinfection of ships by the use of chlorine, and thus did away with the necessity for prolonged detentions at quarantine.

Scientific Circus Attractions.

At the annual opening of the Barnum & Bailey circus for this season on March 22, in this city, in addition to the feat of Mlle. de Thiers traveling through the air gap in her inverted automobile (a novel feature last year), was the introduction of a new attraction styled "The Limit" or in Paris called "The Whirlwind of Death," both of which were illustrated and described in the Scientific American of October 14, 1905. For carrying out this new feat an inclined plane about 40 feet long and 4 feet wide is used. This has a starting platform at the top, and at the bottom a reverse incline for guiding the vehicle upward. Under this is a combination of springs and levers so arranged that when the miniature automobile travels down the incline at high speed a rear shaft on it impinges against two projecting release levers above the short upward incline, thereby releasing a large spring-operated lever lying nearly level with this incline. The lever gives a sufficient impulse upward to the rear of the vehicle to cause the latter to rotate one revolution in the direction of its length while passing through an air space of approximately 25 feet. The machine is timed to land in its normal position upon a thickly-padded, guarded platform, where it gradually stops. Of course the young woman who risked her life was strapped firmly to the vehicle. The act was very successfully carried out and showed skill in securing the right degree of momentum and the correct operation of the mechanism. Were it not for the special apparatus at the bottom, the vehicle would fly off into air space in its normal position and land on the platform beyond. The act occupied about four seconds.

Another new feature was the operation of a gasoline automobile runabout by acrobatic experts much on the plan of bicycle trick riders.

A Dash for the Pole in an Airship.

Mr. Walter Wellman, that notable explorer and journalist who has twice gone to the Arctic regions in attempts to reach the North Pole, expects to start from Spitzbergen the first of August on a third expedition, which will travel through the air in the largest dirigible balloon ever built. The envelope of the balloon is being constructed by Louis Goddard, of Paris. It is to consist of two layers of rubber-covered cotton and one layer—the inside one—of rubber-covered silk. In its central zone, which is the strongest, the envelope is to have a tensile strength of 2,800 kilogrammes per square meter (about 575 pounds per square foot) thus giving a factor of safety of 6 to 1. The average factor of safety is 5 to 1, as against 3½ to 1 of the Lebaudy airship. The form of the balloon is to be maintained by an interior ballonette filled with compressed air by means of a 5-horse-power motor and compressor. On account of the triple rubber layers (which are lapped one inch at the seams and sewed together, and the stitching then covered with cemented strips) the leakage of gas is guaranteed not to exceed 1½ per cent per day. The amount of fuel and supplies consumed daily will more than counterbalance this. The length of the gas bag will be 50 meters (164.04 feet); its greatest diameter, 16 meters (52.49 feet); its surface, 1,960 square meters (21,098 square feet); its capacity, 6,350 cubic meters (224,244 cubic feet); and its lifting power (with gas having a lifting power of 1,130 grammes per cubic meter) 7,240 kilogrammes, or 16,000 pounds. The weight of the balloon is 2,860 pounds, while the framework, steel car, motors, and all other paraphernalia bring this up to a total of 7,500 pounds. This leaves an available lifting power of 8,500 pounds for the crew of 5 men, three or four motor sledges, a metallic boat, and all supplies.

The airship is to have two 4-cylinder water-cooled gasoline motors of 55 and 25 horse-power. The larger motor drives a forward propeller through reduction gearing, and the smaller one a propeller at the rear in the same manner. A speed of 15 miles an hour will be obtainable with the 50-horse-power motor, and 19 miles an hour with both. The total distance to be covered is about 1,200 miles, while the 5,500 pounds of gasoline to be carried should drive the airship nearly twice this distance. This fuel is sufficient for a 140-hour run of the main motor.

Should one motor break down beyond repair, the travelers can use the other one; and if the airship gives out from any cause, the travelers can take to the sledges. A wireless telegraph outfit is to be taken along, so that communication can be maintained with the base as long as possible.

At a meeting of the New York Motor Club on March 23, Mr. Wellman explained fully his plans for the trip, and showed how he has tried to provide for every contingency. The airship is to be transported to Spitzbergen, inflated there, and experimented with during the month of July. If everything works satisfactorily the dash will be made in August and provisions will be carried sufficient for 75 days. Everything has been so carefully planned by Mr. Wellman, who has an intimate knowledge of what is required, that the expedition through the air, if not altogether successful, bids fair to be by no means a dismal failure.

A New Comet.

A cable message dated March 19 has been received at Harvard Observatory from Prof. Kreutz at Kiel, stating that a comet was discovered by Ross at Melbourne, 1906, March 17 d., 914, G. M. T., in R. A. 2h. 3m. 52s., and dec. —7 deg. 41 min. Daily motion in R. A., +3m. 36s.; daily motion in dec. +1 deg. 10 min. The physical appearance of the comet is as follows, viz.: Circular, 3 min. in diameter, magn. 8, some central condensation.

Correspondence.

A Standard of Light.

To the Editor of the SCIENTIFIC AMERICAN:

May I offer an amendment to my previous article on a standard of light which you were so kind as to publish?

The information given by you that selenium is mostly affected by greenish-yellow rays suggested my looking up the elements found in that part of the spectrum. Finding barium, calcium, sodium, strontium, and the other less common elements of that part of the spectrum, impracticable to use in an alloy, it occurred to me that from their nature the oxides of these elements might be suitable in connection with an oxygen-hydrogen flame. IRVING G. CHATFIELD.

Forestville, Conn., March 16, 1906.

Preserve Niagara Falls.

To the Editor of the SCIENTIFIC AMERICAN:

I was interested in the Western letter of some weeks ago advocating the extension of the franchise for the use of Niagara for power. It argued that, as there is a waste of millions of horse-power, it should be used for financial gain to some one. The primary object of making money is to gain happiness—the goal for which the millionaire capitalist is striving as well as the common laborer who hoards his earnings for years that he may able to visit Niagara—the paragon of Nature's wonders. The only question, then, to decide is whether the money obtained from the utilization of Niagara's power will bring more happiness to the human race than Niagara preserved as it is as a wonder of the world.

Let me suggest: If Niagara is to be used up, bit by bit, for power, why not require all companies using the water to so construct the works that the water may be turned back into the river at will. If this were done in each case Niagara could be made to do duty as a wonder once a week at least, even if all the water was used for power. For power to run the machinery of the capitalists during the time Niagara did duty as a curiosity, storage electricity might be used—batteries being charged during the week by surplus power. These suggestions may be visionary, but unless something is done Niagara is doomed. By all means, let us save Niagara.

J. GREENE MACKENZIE.

Ethel, Mo., March 12, 1906.

The Niagara Problem.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of February 24, I was pleased to read a thoroughly sensible and practical article by Irvin A. Fort, North Platte, February 8, 1906, on the Niagara question. I have always been interested in the development of power in any form and particularly in large units. Several months ago I had the opportunity of listening to a lantern lecture by a geologist at Ottawa. The subject was to save the Falls (?). The gentleman speaking was much better versed on rock formation than engineering principles, and, although he allowed the engineers some credit for the wonderful plants, he deplored the waste of power both from overflow and not placing the turbines as low as possible, thus losing several feet of "head." The overflow was the old yarn, that because a few buckets of reserve water are seen coming out at the upper level, therefore, immense power is being wasted, these people rarely watching long enough to observe times when this flow entirely ceases owing to the full capacity being called upon. The other story about the turbines not being set as low as possible was a direct insinuation upon engineering ability and was backed by several diagrams showing a drop of nearly twenty feet in the race-way over a mile in length which emptied directly into Lake Ontario. The idea probably was that one or two feet would have done just as well, as water will generally seek its level, but in this case its level is required to be found in a hurry as there is lots more coming every second. The only wonder to me is, that the gentleman did not advocate placing the turbines on a level with the bottom of the lake, thus adding several hundred feet to the drop. I entertain an idea—perhaps mistaken—that if ever coal and other heating agencies were to become unavailable, these same agitators for the beautiful would change their tune to a more practical strain when cold weather set in. Any figures given above are merely illustrative, as I failed to take notes on the occasion mentioned.

W. L. MCLAREN.

Guelph, Ontario, Canada, February 27, 1906.

The Date of Easter.

To the Editor of the SCIENTIFIC AMERICAN:

Recent queries on the subject of Easter have aroused my curiosity, and as the Church's rule for the adjustment of the embolismic lunations is the simplest possible, I thought it might be interesting to reduce it to a general formula. Easter Sunday being the first Sunday after the 14th day of the "first month," or Nisan, the work depends on locating the latter day. The following is the result:

$$Y = m.19 + R = 4S + r \qquad N = 4n + t \qquad Y + S = m.7 + U$$
$$N - 15 = 25p + q \qquad q = 3x + r$$
$$\left.\begin{aligned} &N + 19R + 29n + 22p + 29x + 10 = m.30 + v \\ &6N + 2t + 6U + 6v + 4 = m.7 + w \end{aligned}\right\} N.S.$$

Y is the numeric of the given year; N, the number formed by cutting off its last two digits; $m.19$, $4S$, etc., the greatest multiples of 19, 4, etc., in the immediately preceding numbers. (When merely the multiple is considered, it is $m.19$, $m.7$, etc.; but if the second factor is required, the multiple is written $4S$, $3x$, etc.) The quantities (R, r, t, U, etc.) following the multiples, are the respective remainders obtained by removing the given multiples. Thus: $1906 = m.19 + R = 4S + r$: dividing by 19 to remove $m.19$, we find $R = 6$; on dividing by 4, we get $S = 476$. For O.S. the cycle being fixed, and every fourth year a leap year without exception, the formula reduces to this:

$$19R + 15 = m.30 + v \qquad 6U + 6v + 6 = 6m.7 + w$$

Easter follows March 22 by $(v + w)$ days, where v depends on the date of the Paschal full moon, and w on the day of the week upon which the latter falls. There are two exceptions, due to the shifting of the cycle to adapt it to the solar year.

1. When $v = 28$ and $w = 6$ with $R > 10$, we must subtract 7, making Easter the 18th instead of the 25th of April. The first instances of this are: 1954, 2049, 2106.

2. When $v = 29$ and $w = 6$, we must again subtract 7 from the final result; putting Easter on April 19. The first instances are: 1609, 1981, 2076, etc. The reason for the difference in the formulas for O.S. and N.S. is the change made in the adjustment of the lunar cycle to the solar year when the calendar was corrected.

As examples, find Easter for 340 and for 1884.

(O.S.) $340 = m.19 + R = 4S + r$, whence $R = 17$, $S = 85$, $Y + S = 425 = m.7 + U$, and $U = 5$.
$19R + 15 = 338 = m.30 + v$; dividing by 30 the remainder $v = 8$.
$6U + 6v + 6 = 84 = m.7 + w$; whence we find $w = 0$.
March $22 + v + w =$ March 30, the date of Easter in 340 A. D.

(N.S.) (As p is evidently zero till the year 4000, we may disregard it, taking $N - 15 = q$.)
$1884 = m.19 + R = 4S + r$; whence $R = 3$, $S = 471$; $Y + S = 2355 = m.7 + U$, and $U = 3$.
$N = 18 = 4n + t$; whence $n = 4$, $t = 2$; $N - 15 = 3x + r$, or $x = 1$.
$N + 19R + 29n + 29x + 10 = 230 = m.30 + v$; and $v = 20$.
$6N + 2t + 6U + 6v + 4 = 254 = m.7 + w$; whence $w = 2$.
March $22 + 20 + 2 = 44 =$ April 13, for Easter Sunday, 1884.

It may be noted that, since the Nisan new moon is never earlier than March 8 nor later than April 5 (ecclesiastical reckoning), the Paschal full moon, or that first following March 20, and which marks the 14th of Nisan, cannot fall earlier than March 21, nor later than April 18. This makes March 22 and April 25 the Easter Sunday limits.

Gauss has worked out a set of Easter formulas, to be used with a table of constants given by him, and I find on comparing the two exceptional cases, that my v and w are the same as his u and v; for the rest, however, the formulas are different, and as these require no table I think them preferable. The week-day formula incorporated in these Easter formulas I have for all dates from the institution of the Julian calendar, 45 B. C., until another change shall be made in the Gregorian calendar. This I will gladly furnish if any are interested.

I have been a diligent reader of the SCIENTIFIC AMERICAN for years; and one thing I have always appreciated has been the sound judgment (and I may also say the patience on many occasions) displayed by the query editor. G. P. BRYAN, S. J.

College of the Sacred Heart, Denver, Colo., March 1, 1906.

The Current Supplement.

The current SUPPLEMENT, No. 1578, opens with a conclusion of Mr. W. J. Harding's thorough review of the development of the torpedo-boat destroyer. The last installment of Mr. J. E. Petavel's instructive paper on the pressure of explosives is likewise concluded. The concrete user will find much that is of value in O. U. Miracle's excellent little paper on the causes of failure in the concrete block business. An entertaining article containing much curious information is that on the forerunners of the automobile. It seems that even as early as 1460 automobiles were not unknown. Of further interest to the automobilist is an account of the metals used in automobile construction. The metallurgist will find in an article on manganese bronze and its manufacture much that is new. Researches on metals of the platinum group are discussed by Prof. Henri Moissan.

Science Notes.

A little more than a year ago there died in Jena, that world-famous town, Prof. Ernst Abbe, who has had no small share in making Jena so well known to the entire civilized world. At the time of his death, papers and magazines contained full accounts of the life and work of this truly remarkable man, reciting in detail his numerous contributions to science and his successful experiment in organizing an industrial enterprise upon distinctively new lines. Since that time the feeling that here was a man whose work has been for the good of mankind and whose memory should be fittingly honored, gathered strength until there was appointed a committee to take charge of soliciting funds for the purpose of erecting in his native town, between the Volkshaus erected by him and the Zeiss works, a statue as a memorial. The names of a number of American scientists and business men who had had dealings with the Zeiss works were included in the committee named. We in America seem very far off from the little German town where the statue to Abbe is to be placed; and one might think it of little account whether we help to erect the statue or not. But this is a unique occasion, as Abbe was a unique man, and most of us who know anything at all about him will consider it a privilege to be able to contribute, be it ever so small a sum, to the statue that is to perpetuate his form to posterity. Contributions may be sent to this office or to the Bausch & Lomb Optical Company, Rochester, N. Y., the American agents of the Zeiss works.

In the course of their researches upon spring water, Messrs. Dienert and Bouquet had occasion to make a number of measurements as to the radio-activity of several springs which go to form the Avre, one of the streams serving for the water supply of Paris. To carry out the measurements they used an electroscope apparatus of the Elster and Geitel type. First, they determined the fall of potential which is obtained by a certain quantity of distilled water after one hour, thus giving the normal activity. In the second case they replaced the distilled water by an equal amount of spring water and made the same reading. Subtracting from the latter the normal activity we have the figure which is due to the spring water in question. The results which they obtained show that the water of the Avre is slightly radio-active, and the Breuil spring is stronger than the others. On coming out of the ground, it seems that the water of the spring contains the emanation which it dissolved out of the soil in the most concentrated state. Around the springs has been built a masonry vault, and it is to be supposed that the air within such chambers is strongly radio-active. They found this to be true, and in the case of the Breuil spring the air was over seven times as radio-active as the air of the laboratory, comparing by the electroscope method. Seeing that at certain points, as for instance when coming out of the soil, the springs seem to concentrate the emanation which they have collected from the soil, we may be able to use this method for revealing the presence of underground springs, and the authors are now engaged in making researches to this end.

A curious effect was noticed in connection with a kinetograph view which was taken in Germany not long ago. It was obtained at the time of the visit of the King of Spain to Berlin and represented the entrance of the procession into the city. The horse guards led off, then a line of carriages and lastly a line of mounted cavaliers. What was surprising about this view was that while the carriages moved in the line of march as they should do, the wheels appeared to revolve slowly in the contrary direction, and thus the spectators had the impression that the vehicles were about to be dislocated and torn apart. In another view of the same scene the wheels did not turn at all, or else swayed slightly to and fro about the center. This phenomenon is easily explained, although at first it puzzled nearly everyone. To take the views we photograph the objects successively within at least one-tenth of a second and then project them in the same order on the screen. In the case of a moving carriage wheel the rotation is suggested to the eye entirely by the displacement of the spokes. But here the kinetograph may be completely at fault. For instance, in one of the views a spoke of the wheel occupies a well-defined position. In the following views if the second, third, and fourth spokes are made to occupy exactly the place of the first in their turn, the successive images of the wheel will not differ from each other. The spectator will therefore not have the sensation of the wheel's movement. According to the relative speed of the wheel and the projection apparatus we may find that the successive spokes have a slight advance or lag relative to the position of the first one and give the illusion that the wheel is turning forward or back, as the case may be.

The question of laying down a second track of rails along the Siberian Railway has been postponed until perfect order has been restored on the line.

BORING OUT COLUMNS IN SOLID ROCK.

BY L. RAMAKERS.

The method of extracting stones by means of wedges driven into them at intervals, or by explosives, is beginning to be discarded in quarries in favor of new processes. The system of sawing by helicoidal cable is becoming more and more widely employed. Utilized at first for forming an entrance to the lower part of strata in working shafts where there existed no entrance with natural slope, it is employed at present for cutting out stone at the adit end of quarries and forming it into blocks. For guiding and carrying the cable, use is made of a tubular support provided with two channeled pulleys, one of them mounted upon a fixed support at the upper part, and the other upon a movable one sliding along the entire length of the tube. The displacement of the movable support is effected by a long screw parallel with the tube and which gives the wire the pressure necessary for the sawing of the stone. For the sawing of a detached block, the mounting of these tubes on both sides of the block is done very easily. But the case is entirely different when it is desired to saw in a stratum in which no break occurs. In such an event shafts about thirty-six inches in diameter designed for the reception of the tubes are formed at the extremity of the length that it is desired to saw. In hard stone (such as bluestone) the shafts are driven at distances varying from 35 to 50 feet, while if it is a question of soft stone they may be driven at a distance of 120 feet from each other.

The Société de Constructions Electriques de Charleroi (Belgium) is constructing for the sinking of shafts a special drill actuated by an electric motor. The essential part of this machine consists of an iron plate cylinder 140 inches in height and 36½ in diameter, at the base of which is mounted a knife 12 inches in height. The knife also is cylindrical and upon its lower part are formed alternate teeth upon concentric circumferences. This arrangement of teeth in two rows permits the knife to attack the stone better, and to widen the space in which the cylinder moves. After the shaft is driven, the cylinder and the internal core of stone may be removed.

The cylinder and knife system receives a circular motion of 50 or 60 revolutions through the intermedium of a square rod to the upper end of which is keyed a helicoidal wheel, which engages with an endless screw upon the shaft of the electric motor.

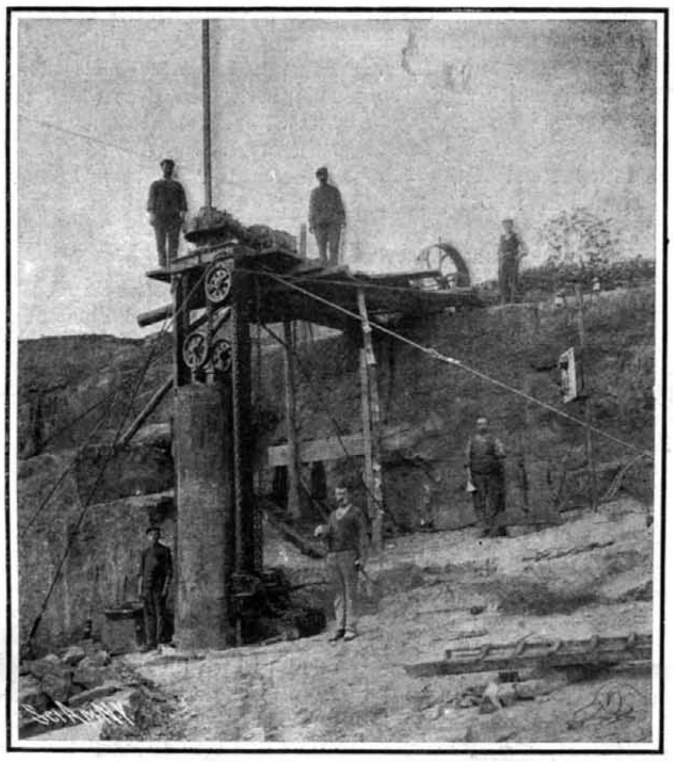
The knife-carrying cylinder was formerly actuated by the helicoidal cable that saws the stone, or by any sort of electro-dynamic drive; but all such transmissions had certain faults, and their efficiency, moreover, was unsatisfactory. The endless screw is much more certain in its action, its operation noiseless, and its efficiency very high. Its axial reaction is produced upon accurately calibered steel balls. The square rod, through a sleeve, carries along the cylinder, and permits it to descend in measure as the work advances. The weight of the iron plate alone causes the descent of the knife. The sleeve is held in the axis by a movable guide sliding in three uprights of U-iron, forming the frame of the apparatus. In order to facilitate the boring of the stone, some fine granules of tempered steel and some water are thrown from time to time into the groove of the drill.

As the entire apparatus has to be often shifted, the motor is in no wise sheltered, and so it is of the hermetic type. It is from 20 to 25 horse-power.

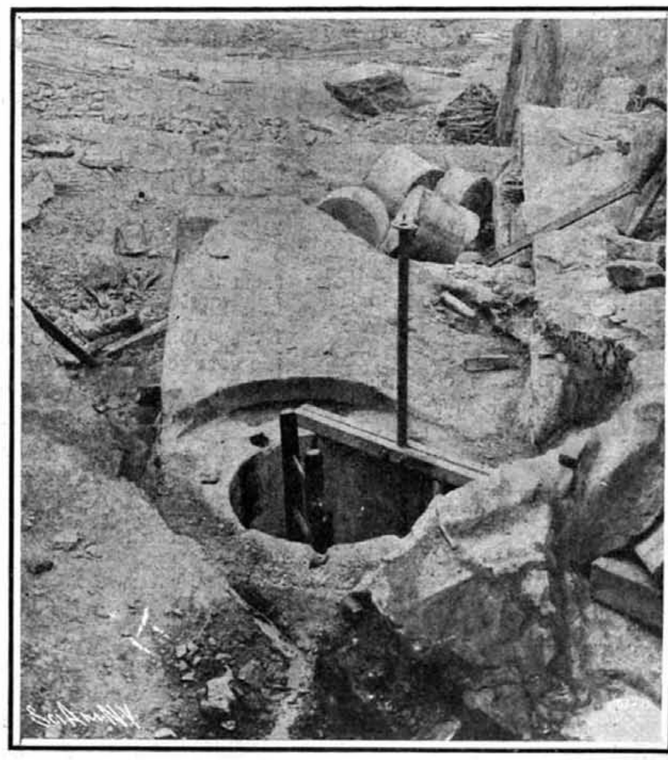
When the operation of boring is finished and it is a question of removing the cylinder and the internal core, a hand windlass fixed to one of the uprights of the frame is employed. This windlass takes the cylinder by the upper part, while as for the core, a hook is first inserted therein, after which it is broken by driving wedges into the groove formed in the drill.

When it is desired to bore deep holes, a second cylinder of 140 inches diameter may be superposed; and sometimes even a third and fourth are added. In this way shafts of 50 feet in depth have been sunk. As a general thing, however, the boring is not done to a depth of more than 25 or 35 feet.

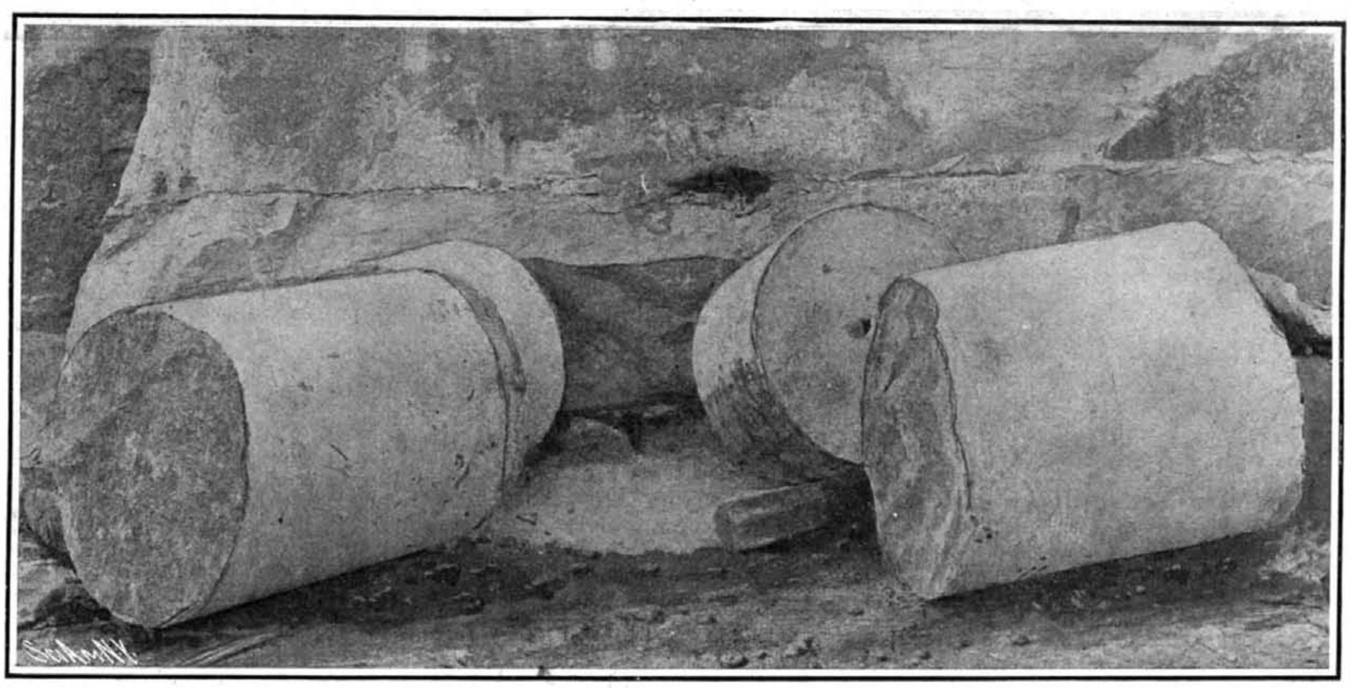
The advance of the work varies greatly with the hardness of the stone. At the Hainaut quarries (Belgium) where blue-stone is extracted, the above-named establishment has installed a type of drill capable of driving a 13-foot shaft in ten hours.



The Circular Cutter at Work.



Pits Dug by the Circular Cutter.



Portions of a Granite Core Extracted by Circular Cutting.

BORING OUT COLUMNS IN SOLID ROCK.

A Seven-Ton Pump as Evidence of Patentability.

Sometimes the rigors of Patent Office procedure are not without their humorous side. A New York attorney filed an application for improvements in a centrifugal pump. The Patent Office declared the invention inoperative and demanded a working model. The Patent Office was requested to send an examiner to Trenton to inspect the machine in actual operation. But this the Patent Office refused to do. The attorney, therefore, politely sent a seven-ton pump to the Patent Office—sent it, moreover, from Trenton to satisfy a skeptical examiner. Twenty-one men were required to get it into the examiner's office.

ARTISTIC FRENCH TAXIDERMY.

BY JACQUES BOYER.

Time was when museums of natural history were filled with stuffed animals, mounted in stiff, unnatural attitudes, veritable caricatures of the creatures which they professed to represent. It was deemed sufficient to rub skins with arsenical soap and stuff them with hay or tow, and Agassiz was justified in writing: "Stuffing a skin is equivalent to destroying it."

The taxidermist of to-day, on the contrary, takes great care to preserve the appearance of life and to mount single animals and groups with all possible realism.

Artistic taxidermy had its beginning some twenty years ago when Jules Vernaux mounted a group of lions attacking an Arab courier, which created a great sensation. Soon afterward, Mr. William T. Hornaday, who had been sent by a great London firm to the East Indies to study the orang-outang in its native forests and to collect skins and skeletons, determined to reproduce some of the curious scenes that his pencil had caught. On his return he composed a masterpiece which was purchased by the American Museum of Natural History in New York. It represents two male orangs fighting for the possession of a young female that is shown fleeing from her nest in a treetop, with her baby clasped to her breast. One of the rivals has overpowered the other and is biting his hand. The face of the vanquished combatant is distorted with rage and pain. Several simian spectators awakened by the fray, are viewing the scene from their arboreal homes. The group is a sculptural monument worthy of Barge or Frémiet.

French taxidermists soon followed the example of Vernaux and his successors, notably Hornaday, Ward, and Dyche.

The old absurdities were abandoned and the art has now reached a high degree of perfection in France.

The tools of the taxidermist are simple. They comprise sharp scalpels, dissecting pincers, mallets, saws, files, scissors, awls or large needles for sewing, steel punches for perforating bones and claws, bristle brushes for applying antiseptics, badger brushes for arranging fur and feathers, and iron wires of various sizes for supporting the specimens and attaching them to their pedestals.

In preparing a large animal, like a tiger, for mounting, the flesh is carefully dissected away and the bones are cleaned. Next, the skin is freed from adhering fat by scraping with a thin-bladed knife and rubbing with plaster. It is then soaked in an antiseptic bath (usually a solution of alum and common salt) which prevents the falling of the hair and the development of injurious insects.

Skins of small animals, such as rats and squirrels, are coated inside with arsenical soap—a mixture of white soap with arsenic, camphor, and potassium bitartrate, which was invented by the pharmacist Becœur.

These manipulations, which vary somewhat according to the nature of the subject (mammal, bird, fish, or reptile) constitute, so to speak, the manual and me

chanical part of taxidermy. The artistic part is the mounting.

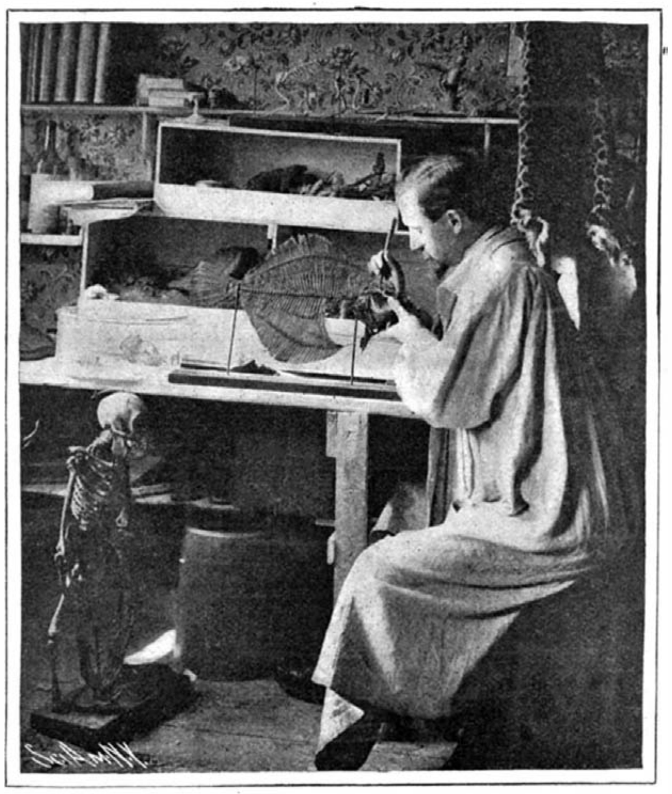
The taxidermist first selects the wires which are to form the framework and support of the specimen. These are passed along the bones, and the legs, thighs, trunk, and neck are then stuffed successively. Cotton is used for small birds; tow, hay, or straw, for wolves, deer, horses, and other large quadrupeds.

The openings in the skin are now sewn up with strong waxed thread and the hair is combed over the sutures. Parts which are too prominent are flattened with the mallet and sunken parts raised by inserting an awl and using it as a lever. After all this the animal must be arranged in a natural attitude.

Modern French taxidermists prefer to replace the skull and jaws with forms made of paper, which make it possible to imitate nature to perfection and more expeditiously than could be done with tow, especially for heads of skins which are to be displayed flat, or used as rugs.

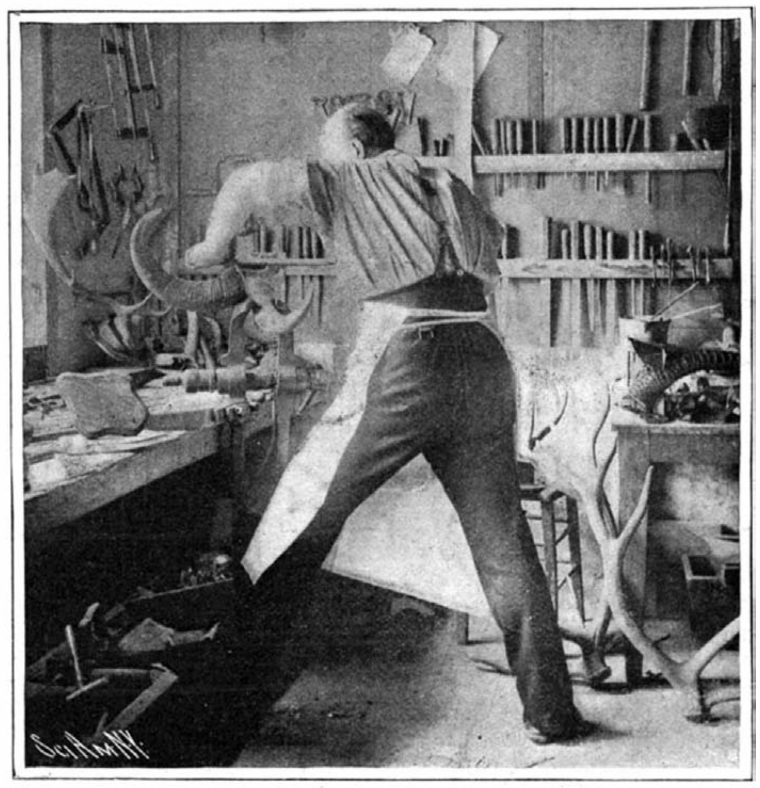
Such artificial heads for common animals, including dogs, cats, wolves, foxes, deer, bears, tigers, and lions, are made in great numbers in a factory at St. Maur, near Paris, in the following manner: A plaster mold of the natural skull is lined with several sheets of paper, applied one by one and fastened together with glue. This paper cast, after drying, is very hard and tough. This work is done by women, and other women cast, in leaden molds, composition jaws with teeth, which exactly imitate the dentition of the various species. Tongues are made in a similar way and are colored by young apprentices. The parts having been finished with the file, polished and assembled, a decorator gives the finishing touch by applying the proper colors to the nostrils and the tip of the muzzle.

The taxidermist buys these factory-made heads and puts on each the proper sterilized and wetted skin which he secures by a row of small tacks extending from the nose to the top of the head. Then he seizes the skin with pincers and stretches it over the cheeks, fastening it with more tacks. All these tacks are removed after the skin has become dry, but a row of nails inserted around the throat is allowed to remain. After drying, too, the head is combed and brushed and the painted parts are retouched, if necessary. Next,



Dissection of a Flat-Fish.

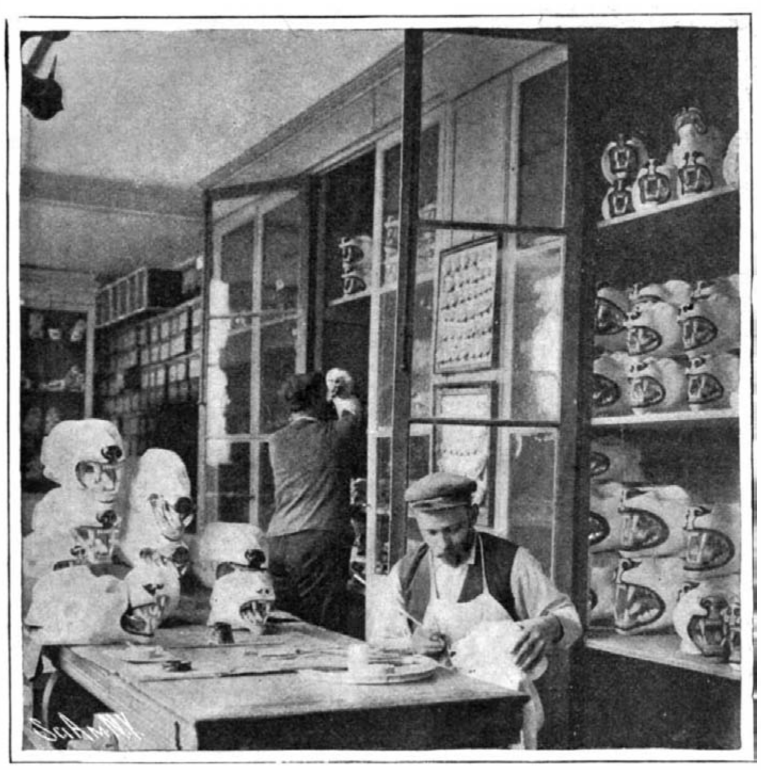
A Stuffed Snake.



Preparing Horns for Mounting.

Making Teeth and Jaws.

Coloring Artificial Tongues.



Painting the Paper Heads.

A Naturalist "Pairing" Artificial Eyes.

ARTISTIC FRENCH TAXIDERMY.

the eye sockets are filled with wet tow in order to soften the lids. On the following day the tow is removed and the eyelids rounded. Glue is then applied to the interior of the eye sockets and glass eyes are inserted—yellow, blue, red, brown, or black, with round or oval pupils, according to the species. As commercial glass eyes made for the same species often vary in size, they must be carefully measured and assorted into pairs of eyes as nearly alike as possible.

The preparation of birds is less difficult than that of mammals, but the preservation of their brilliant colors necessitates certain precautions. If stained with blood they are first washed with soap and water, dried with a fine towel, and dusted with plaster. When this has hardened it is removed, and the operation is repeated until the feathers have regained their original luster. Bird lime is removed by rubbing with olive oil or fresh butter, scraping with the scalpel, washing successively with strong potash lye and pure water and drying with fine plaster. The removal of grease exuding from wounds demands still greater care. Several methods are given in technical works. The best, according to Boitard, consists in brushing the spot lightly with turpentine and washing it successively with potash, alcohol, and water. If all this fails, the damaged feathers must be replaced by feathers taken from another bird of the same species.

The cleaning finished, the bird must next be carefully measured before skinning, in order to preserve the correct proportions in the mounted specimens.

In France, the incision needed for skinning is made along the median line, from the gullet to the abdomen. The skin is detached with the scalpel, scraped to remove grease and bits of flesh, and brushed inside with arsenical preservative.

After it has received a skeleton, consisting of a wire running from the head to the tail, with branches for the wings and legs, the skin is stuffed, beginning with the neck. The bird is now said to be *"en peau,"* or "in its skin." If not mounted at once it is wrapped in paper to protect it from insects, dampness, and, as far as possible, desiccation. If it is kept for several months it must be softened before mounting, in order that it may be posed effectively, with wings raised, tail spread, etc. Whatever the attitude chosen it is maintained by linen bandages until the specimen has become quite dry.

The bills of some birds, notably the immense bill of the great toucan, fade slightly after death and must be retouched. The same applies to the brightly colored feet of certain species.

Snakes are usually extracted from their entire skins through the throat, but first, if the species is venomous, the fangs are drawn and the poison glands are seized with pincers and cut off with scissors as close to the jaw as possible. Sometimes it is necessary to make an incision a few inches long in the belly in order to remove all the flesh and viscera. After the skin has been treated with preservative it receives a spine made of wire wrapped with tow and is then stuffed, sewn up, and bent into the form desired. It is next washed with water or alcohol, dried with a towel and freshened by brushing with turpentine. After receiving glass eyes, wax poison glands, artificial fangs, and a coat of varnish it is ready for exhibition. Lizards are prepared in a similar manner.

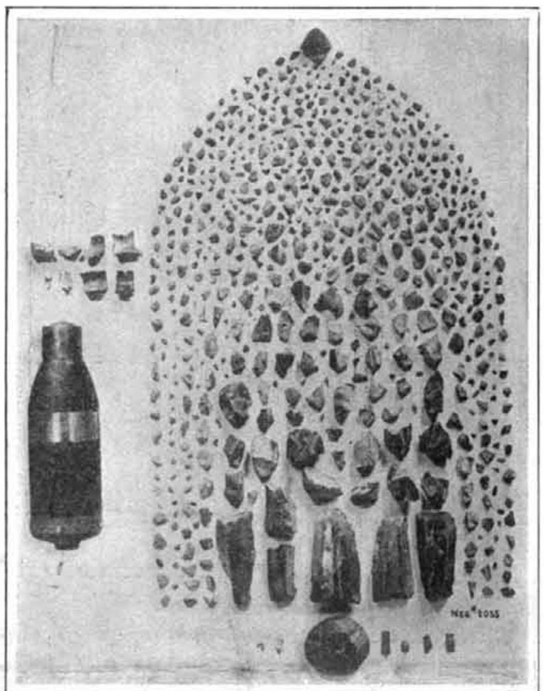
Large fishes, such as the shark and the dogfish, are also treated in nearly the same way. Few small fishes are mounted in France, because there is at present no known method of preserving the brilliancy of their metallic colors. French taxidermists, therefore, prefer to preserve such specimens in alcohol or to prepare and mount their skeletons, which they do with rare skill.

Such, in brief, are the methods now employed in French taxidermy, which tends more and more to become a highly artistic science.

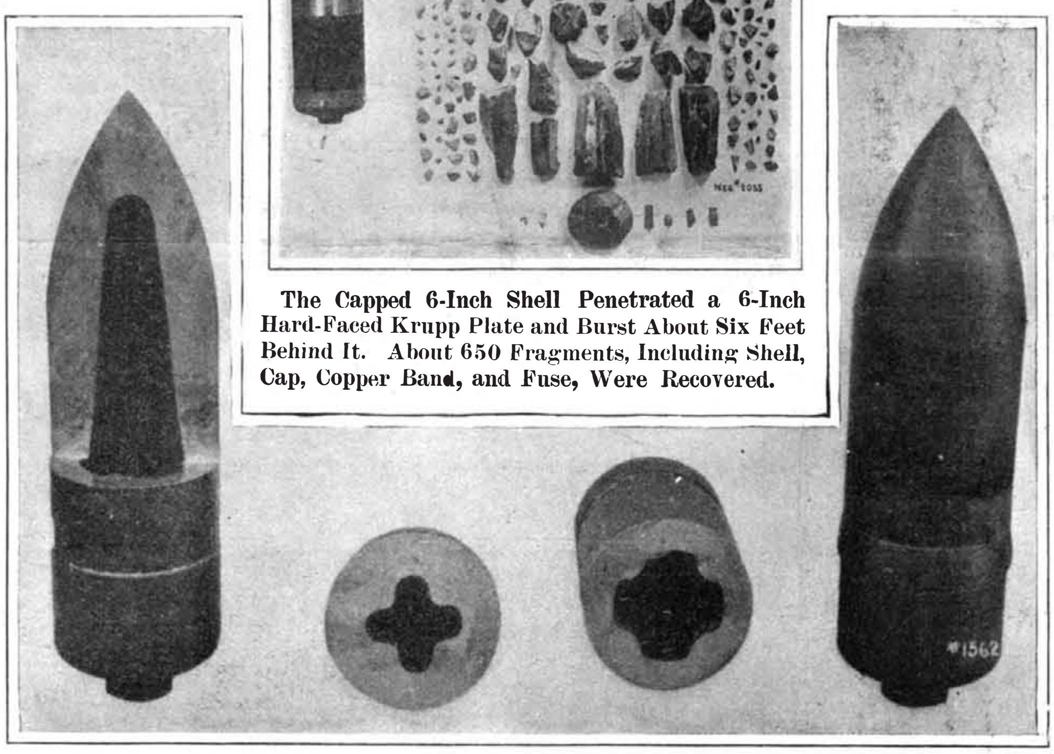
What is said to be the highest dam in the world has been built on the Salt River, Arizona, and will submerge and completely obliterate the town of Roosevelt. The work is well under way, and it is expected, says the Iron Age, that by 1908 the town will be 172 feet below the surface of the water. It is expected that the head obtained will be the means of securing abundant power. A temporary power plant, a cement mill, ice plant, lighting plant, and saw mill have been completed. A telephone line has been installed to the head works of the power canal, 18 miles above Roosevelt, and extended in the other direction to the site of the great dam, which is 30 miles from Phœnix.

NEW TYPE OF ARMOR-PIERCING SHELL.

We show illustrations of a new type of armor-piercing shell which was tried recently at the proving grounds of the Bethlehem Steel Company, makers of the shell, and gave remarkably good results. The problem confronting the manufacturer is to make a shell and fuse which will penetrate modern face-hardened armor, and burst after it has passed through the armor and is within the ship or fortification, as the case may be. Three elements enter into this problem. First, to protect the head of the shell while it is forcing its way through the intensely hard, carbonized surface of the plate, and prevent it being shivered into fragments; secondly, to provide sufficient strength in the walls of the body of the shell to prevent their collapsing or crumpling up under the momentum of the after body of the shell; thirdly, to provide a fuse which will automatically delay its action until the shell is just clear of the plate and explode the charge at the critical moment, scattering the fragments among the crew and upon the light interior structure and mechanism of the ship or fort.



The Capped 6-Inch Shell Penetrated a 6-Inch Hard-Faced Krupp Plate and Burst About Six Feet Behind It. About 650 Fragments, Including Shell, Cap, Copper Band, and Fuse, Were Recovered.



The 6-Inch Capped, Ribbed-Cavity Shell Which Was Loaded with Black Powder and Exploded Six Feet Behind a 6-Inch Kruppized Plate.

NEW TYPE OF ARMOR-PIERCING SHELL.

The lower photograph shows longitudinal and transverse sections through a 6-inch armor-piercing shell of the new type above referred to. It will be seen that instead of a circular cross section the interior wall has a ribbed outline. The ribbed form is adopted because of the belief that these shells are stronger for penetration and better able to withstand deformation or complete breaking up. The upper photograph represents 650 fragments, including shell, cap, copper band, and fuse, which were recovered from a 6-inch capped armor-piercing ribbed cavity shell loaded with black powder after it had passed through a 6-inch Krupp plate and burst about 6 feet to the rear of it. The original weight of the shell empty was 102½ pounds. The total weight of recovered fragments was 94 3-16 pounds. The weight of the largest fragment recovered was 10¼ pounds, and the average weight of the fragments was 2 5-16 ounces. We are informed by Mr. John F. Meigs, to whom we are indebted for our information and photographs, that not only have the ribbed projectiles proved better able to withstand the heavy end-on pressure, but the number of fragments into which the shell is burst is greater than when the shell cavity is circular.

A PUZZLING BIT OF FOUNDRY WORK.

BY C. METCALF.

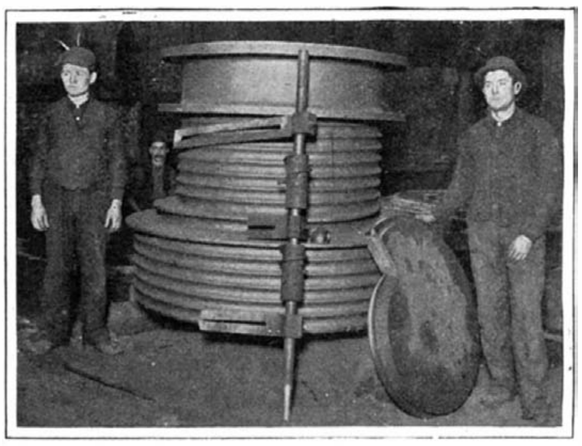
The job foundryman, whose work is usually of the most varied sort, occasionally meets with a particularly knotty problem. A case in point is illustrated in the accompanying engraving, which is a photograph of a double, grooved drum, recently made by the Metcalf Iron Works in South Brooklyn. It measures 5 feet 6 inches on the larger diameter, 4 feet on the smaller diameter, and is 4 feet 9 inches deep. The drawings and specifications for the drum were rather meager, but the work did not promise any special difficulties. However, the apparently simple drum proved to be much more troublesome than we had imagined it. This was due to the fact that a connecting groove was required between the two drum faces, also that a deep flange was necessary at each side of the groove to prevent the cable from slipping off when winding from one drum face to the other. No patterns for the drum were supplied, and the only thing we had to work from was a single blue-print. Our method of procedure is illustrated by the accompanying engraving, which is really a composite view showing at the left half a section of the mold after being struck up, and at the right half the sweeps used in forming the mold. The process of loam molding, while common among founders, may not be familiar to many of the readers of the Scientific American, and may, therefore, need a somewhat detailed description.

First a spindle plate was laid and a "transient" or removable spindle mounted to turn in a bearing in this plate. A board or sweep was secured to the spindle by means of a strap, and the spindle was then revolved so as to sweep up a bed for the bottom plate. On this plate the brickwork was built. The sweep 1, shown by broken lines in the engraving, was now used for striking up a bearing for the lifting ring. This sweep was fastened to the board 2, which was later used to strike up the recess for the lower flange of the drum. A "crab-iron" was laid over this flange, and the brickwork was carried up to the height of the second flange of the drum. This brickwork was well plastered with wet loam and then the board 3 was used to sweep up the belt face of the drum as well as the upper flange and the bearing of the next plate. The sweep 3 was now removed and sweep 4 was secured to the spindle. The outer edge of this sweep was cut, as shown in the engraving, to form the spiral groove called for in this portion of the drum. This edge was protected while building up the brickwork, by means of a strip of wood bolted to the sweep and overlapping it a fraction of an inch. The overlapping strip served as a gage for laying the bricks at the proper distance from the sweep. After the bricks had been well plastered with loam the protecting strip was removed, the set screws fastening the straps to the spindle were loosened to permit axial movement of the spindle, and the sweep was supported by a "finger" bolted thereto, and resting on a spiral thread or worm formed on a sleeve which was secured to the spindle. The sweep 4 was now revolved about the stationary spindle and was caused by the worm to follow a spiral course, forming in a single turn the entire spiral groove of the smaller drum face.

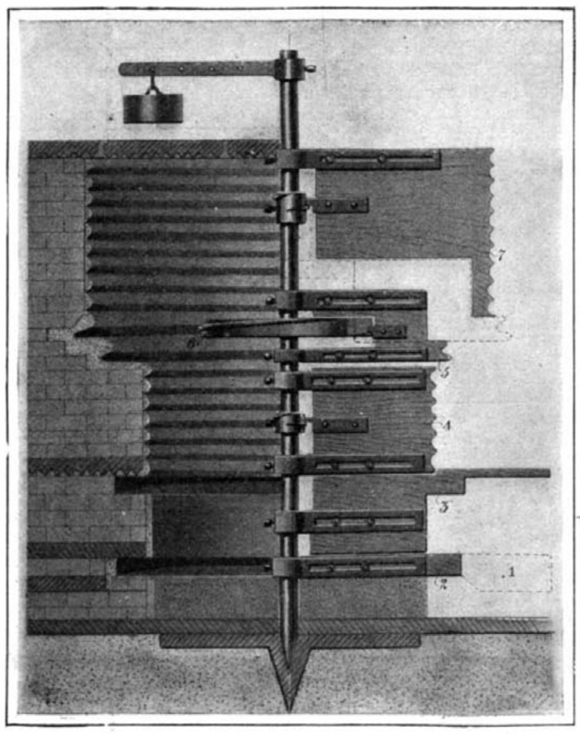
The process followed thus far is not unusual among founders. It was the next step that called for originality. The connecting groove leading to the larger drum required not only a spiral thread, but a scroll or snail to carry it from the smaller diameter out to the larger one. A snail cam was therefore made of the form shown in the photograph. On the edge of this cam a thread was formed of the same pitch as that of the worm, namely, 2⅝ inches. The layout of this thread was in itself quite a difficult task. The cam was made of wood, and the thread was smoothed up with a little oil and lead. Board No. 5 was now set to engage this cam 6, which was secured at the desired position on the spindle. The board was attached to a pair of straps by means of bolts adapted to slide in slots in these straps. This permitted the outward movement of the board, while the straps were free to slide on the spindle to allow for the necessary axial movement. A single turn on the stationary cam carried the sweep up to the position shown by dotted lines, thus completing the connecting groove. To insure easy working of this sweep a rope was tied to the outer end of the upper strap and fastened to a collar at the top of the spindle so as to support the

weight of the sweep. After the connecting groove had been completed, another difficulty arose due to the flange called for at each side of this groove. If the groove were continued on the same pitch, one of these flanges would be cut away. The only solution of the difficulty was to change the pitch for the first turn of the groove on the upper drum face. The thickness of the flange called for was one inch. Hence, a worm of 3⅝-inch pitch was made and secured to the spindle. One turn was then made with this pitch after which the remainder of the groove was struck up with board 7, which was operated like board 4 on a 2⅝-inch pitch.

The spindle was now removed and the mold or "cope," as it is called, was lifted from the "drag" or bed. This was done by making fast to lugs on the lifting ring. The grooves were smoothed up and blackened, then treated with a coat of molasses water and lead and the mold was finally baked. The other details of the operation need no explanation. The core was swept in segments of one-sixth of a circle and pieces were bolted onto the sweep which could be taken off when a core was made so as to get the proper thickness at the connecting groove. The total weight of the casting was 7 tons.



A Double-Grooved Drum and Cam Used in Striking Up the Mold.



Method of Striking Up the Mold.

A PUZZLING BIT OF FOUNDRY WORK.

THE WALSCHAERT VALVE ON AMERICAN LOCOMOTIVES

America's contribution to the development of the steam locomotive during the past twenty-five years has consisted chiefly in a very successful effort to develop its power and keep pace with the ever-increasing demand imposed by heavier rolling stock and longer trains. Only those who have closely observed the growth of the locomotive have any idea of the extent to which its hauling power has been increased; and for many years past we have been far in the van among the great locomotive builders of the world in this one particular. We were the first to insist upon the fact that, whatever changes and improvements might be made in cylinders and general running gear, whatever type of driving-wheel arrangement might be used, the ultimate factor that will determine hauling capacity is boiler power. The result is that to-day, in spite of the fact that foreign builders have followed our lead and are everywhere increasing the size of their locomotive boilers, it is in this country that the most powerful engines are to be found. In the great mountain-climbing locomotive, now at work on the Baltimore & Ohio Railroad, which is capable of exerting a tractive effort of 42 tons at starting, and from 30 to 37½ tons at moderate speed, we have a locomotive which is not only by far the most powerful in existence, but has proved itself, in spite of its enormous weight and many novelties of design, to be an exceedingly satisfactory investment.

At the same time, in our effort to obtain power we have rather neglected the question of efficiency, whether it be sought in the direction of details of boiler design, in the use of superheaters, or in the refinement of the valve gear. This matter, however, is now receiving the attention of the master mechanics of our railroads and our leading locomotive builders. A notable improvement, which is making its way quickly in favor, is the introduction of the famous Walschaert valve gear, which has been doing such splendid work on continental railroads. It forms the characteristic feature in the handsome locomotive which we herewith illustrate, which has recently been put in service by the Pennsylvania Railroad Company, and assigned to the important duty of hauling the crack eighteen-hour train of that company that runs daily between New York and Chicago. A study of the photograph shows how the motion is transmitted from a supplementary crank on the outside of one of the driving axles to the valve. Those who are familiar with the Atlantic type of express engines which have been hauling the fast trains on this system for the past few years will see that the new engine, except for the valve-gear connections, is built on the same general lines as its predecessors. It is a simple engine with two outside cylinders 22 inches in diameter by 26 inches stroke, connected to four coupled driving wheels 80 inches in diameter. The boiler is run under a working pressure of 205 pounds to the square inch. The maximum tractive effort at starting is 25,800 pounds.

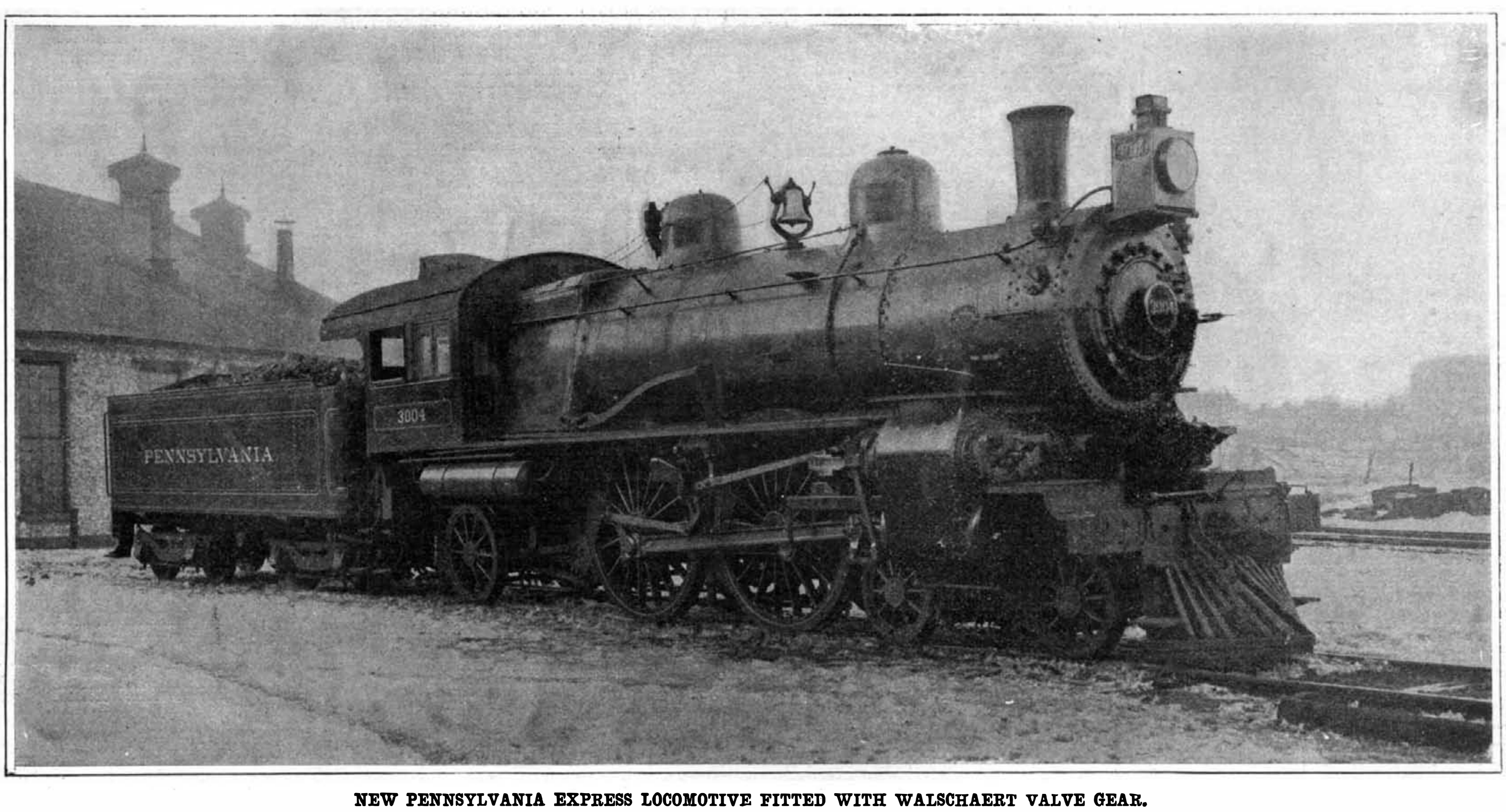
The Walschaert gear is not by any means a new device; in fact, it belongs to the earliest days of locomotive history, having been in use since the year 1844. About 90 per cent of the main line locomotives on the continent of Europe are equipped with it, and it was shown on twenty-five out of thirty-one locomotives exhibited at the Liége Exposition. As compared with the Stephenson gear, there are some advantages of steam distribution and control; but it is equally, if not more, on account of the advantages which it offers from a constructive and operative point of view that it has won its way to recognition by the leading manufacturers. It is more accessible than the Stephenson gear, especially on large locomotives on which the eccentrics are necessarily crowded and difficult to get at except when the locomotive is over a pit. Also in a heavy passenger engine there is a saving of as high as 1,745 pounds over the Stephenson gear. The Walschaert gear is also more direct in its action, the power being transmitted to the valve in comparatively straight lines instead of by rocker arms, shafts, etc., which are more or less yielding and liable to spring. It avoids the wear which is involved in the use of large eccentrics, to say nothing of the lost motion resulting from the rapid deterioration that occurs in the Stephenson links. Incidentally, moreover, the removal of the valve gear to the outside of the frames renders it possible to give the latter more efficient bracing.

Phototegy.—Something New in Photography.

"The Illustration (Paris) describes as follows a very curious process of photographic development called 'phototegy' (from the Greek signifying 'to dye'). Cleansing the plates with oxygenated water had already been tried, but the results obtained were both slow and irregular. The following formula expedites and regulates the action peculiar to this liquid, which is to remove from the negative thicknesses of gelatine proportionate to the opacity of the parts reduced, i. e., attacked by the light:

Water	100 cc.
Muriatic acid	10 cc.
Bioxide of barium	4 gr.

"We should exclude too astringent developers, and employ by preference ferrous oxalate or diamidophenol. After development and washing, the glass is placed in the solution of oxygenated water (in broad daylight, if we wish). The blacks come off in a few minutes, and we obtain directly a foundation composed of reliefs. The picture naturally absorbs quantities of coloring liquid proportionate to the thicknesses of the gelatine. We may then by a subsequent dipping give to the plate the hue that we desire; we shall be able, further, to obtain proofs of it upon paper by simple contact. Finally, in coloring the plate by brush with uniform tints the handling of the shades will be obtained automatically."



NEW PENNSYLVANIA EXPRESS LOCOMOTIVE FITTED WITH WALSCHAERT VALVE GEAR.

Cylinders, 22 inches diameter by 26 inches stroke. **Drivers,** 80 inches diameter. **Steam pressure,** 205 pounds. **Maximum tractive effort,** 28,500 pounds.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

LIGHTNING-ARRESTER. — F. K. SINGER, Wheeling, W. Va. The devices comprise both a fuse and a spark gap, both of which are supported from a base. The fuse is arranged within a vertical tube of fiber through which the fuse passes near the upper end and is connected with a choke coil, the latter in turn having connection with a cross bar provided with a depending champing wing which coacts with a line carbon, said carbon and a ground carbon being separated by a disk of mica to produce the spark gap.

Of Interest to Farmers.

POST-HOLE DIGGER.—C. W. VAN DE WALKER and R. T. JENNEY, Two Rivers, Wis. This improvement refers to tree-planters and post-hole diggers. These devices usually comprise a vertical handle provided with a scoop or cutter at its lower extremity, which is adapted to be forced into the ground and enables the dirt to be removed. The object is to provide a construction for the cutter and means for operating the same with a view to increasing the efficiency of the device in raising the earth from the hole.

Of General Interest.

MEMORANDUM-BOOK.—J. J. HOEY, New York, N. Y. It is expected that the invention will be most useful for keeping small memoranda which would be of temporary character and which would be torn from the book in a short time. Where an ordinary note-book would be used for making entries of this kind, these entries would be scratched off from time to time, and considerable time would be consumed in looking through the pages to find a particular memorandum. The special purpose is to facilitate the finding of memoranda which are still useful and preserved in the book.

OIL-PRESS.—J. C. RICHARDSON, Altonpark, Tenn. This invention relates to continuously-acting presses of the type employing an endless chain of press-boxes and a similar chain of boxes and followers being arranged on suitably-supported driving rollers or drums. The object is to provide a press of this general character involving novel and simplified construction adapted for effecting new and improved compressing action over all similar continuously-acting endless-chain presses.

CAT-GUARD.—F. H. PALMER, New York, N. Y. In this patent the object of the invention is the provision of a new and improved cat-guard more especially designed for use on the top of fences, railings, and like structures for preventing cats and other animals from using or crossing the structure.

FURNITURE-DISPLAY RACK. — C. McCLOSKEY and J. McLAUGHLIN, Sedalia, Mo. The rack comprises vertical standards spaced apart and having horizontal feet for supporting them. Bars connect their upper ends and are spaced apart and adapted for vertical adjustment on the standards, and brackets having horizontal and vertical members. The former are provided with hooks to engage the top bar, the horizontal members projecting laterally from the top bar to adapt them to support articles of furniture, the vertical members bearing against the lower cross-bar of the frame. The brackets may be placed at different distances from each other, or the ends of the frame.

CONVEYING DEVICE.—I. E. BENDICKSON, Cambridge, Wis. While capable of general use the device is especially adapted for application to a trolley system for cleaning out stables and for similar purposes. Principal objects are to provide a construction of frame for supporting a carrier mounted in such a manner as to be easily dumped and formed in such a way as to readily discharge all material therefrom when moved to dumping position. Means provide for controlling the dumping of the carrier and for keeping the frame on the trolley-track.

Heating and Lighting.

GRATE.—O. E. HALDERMAN, Marion, Ind. Mr. Halderman's invention relates to grates, and has for its principal objects the provision of a strong and durable device, which may be efficiently operated. The spaces between the successive bars are entirely unobstructed and the supporting shaft and arms are so located as not to be subjected to extreme heat, therefore rendering the structure more durable.

Household Utilities.

MEAT-ROASTER.—D. G. WALKER, Lindsay, Neb. In this patent the invention has reference to culinary vessels; and its object is the provision of a new and improved meat-roaster arranged to insure automatic and proper basting of the meat without loss of the meat-juices and the basting fluid used.

SAD-IRON.—F. W. KELLERMAN, Weymouth, Mass. This inventor employs an iron having a body within which is supported a movable horizontal partition dividing the interior of the body into an upper and forward chamber and a lower combustion-chamber, in which latter is mounted a vapor-burner. Supported in the upper chamber is a vapor-generator in communication with which is a conductor for the vaporizable fluid leading from the supply-tank for such fluid, suitable valves being employed to regulate the passing of the fluid to the conductor, as well as the passing of the generated vapor to the burner.

Machines and Mechanical Devices.

COMBINED DRILLING AND BOLT-CUTTING MACHINE.—K. C. DAVIS, Ely, Nev. The machine is intended for general jobbing work in drilling or screw-cutting on bolts, rods, or the like, a prominent feature residing in a novel tool carrier of tubular form and having elongated exterior grooves or teeth. The upper end of the tool holder is vertically movable in sleeves supported from the spindle of a drilling machine, and the elongated teeth are continually in mesh with a driving pinion on the spindle; the arrangement being such that the tooth holder can be adjusted readily according to the size and character of blank being operated upon.

Railways and Their Accessories.

AIR-BRAKE APPLIANCE. — H. C. LUCK, Telluride, Col. In this patent the invention has reference to fluid-pressure brakes for railroad trains; and its object is the provision of a new and improved air-brake appliance arranged to automatically set the brakes in the train in case any one of the cars in the train becomes derailed.

CAR-COUPLING.—C. McCARTER, Indianapolis, Ind. The device is of the Janney type and its features adapt the coupling for a reliable automatic coupled engagement with a similar coupling, enable the quick and safe detachment of two of the couplings and provide means for an automatic release of two couplings on adjacent cars in a moving train if the fastenings of either of the coupled car-couplings become loosened and liable to detachment, thus severing the train and avoiding accidental derailment of a portion that might result if the loose coupling fell upon the track.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Inquiry No. 7976.—Wanted, address of the manufacturer of Brooklyn Vapor Bath.

Inquiry No. 7977.—Wanted, address of party making the Hat-Justman or the Just-Hatman milk evaporating system.

Inquiry No. 7978.—Wanted, the addresses of manufacturers or jobbers of bentwood, who can furnish ash, hickory or oak bows 30¼ inches long by 12⅛ inches high, inside measurement, and ½ inch thick by ⅞ inch wide, also bows 15⅛ inches long by 13 inches high and 1¼ wide by ⅜ thick.

Inquiry No. 7979.—Wanted, the address of manufacturers or jobbers of a thoroughly waterproof, durable and flexible canvas 30 inches wide.

Inquiry No. 7980.—For manufacturers of boilers of 25 h. p., horizontal, to supply steam for jacket kettles and for power to run different machinery in the plant; something which is a quick steamer with low fuel consumption.

Inquiry No. 7981.—Wanted, address of firm who will install an aerial cable conveyor road for lumber from a mill about one mile to railway switch or siding.

Inquiry No. 7982.—For manufacturers of engine for self-threading or automatic needles both for hand and machine sewing.

Inquiry No. 7983.—Wanted, addresses of American poultry exporters.

Inquiry No. 7984.—For manufacturers of metal tips for pen holders (that is, the part the pen goes in), also who make and sell celluloid of various colors, widths and lengths, ⅛ to ¼ of an inch thick.

Inquiry No. 7985.—For manufacturers of confetti machines for cutting paper.

Inquiry No. 7986.—For manufacturers of gazing globes for gardens. (It is a globe made of looking glass.)

Inquiry No. 7987.—For manufacturers of X-ray outfit for examining the insulation of electric cables.

Inquiry No. 7988.—For manufacturers of machinery for making fireworks.

Inquiry No. 7989.—For manufacturers of microphones (telephones) for submarine purposes, such as in use on the steamers on Hamburg-American Line to detect approaching steamers when night or in foggy weather.

Inquiry No. 7990.—For manufacturers of apparatus for extracting sap (juice) of the rubber tree, not for preparing the rubber, but for tapping the juice from the trees.

Inquiry No. 7991.—For manufacturers of small chain, steel, aluminum or other sort.

Inquiry No. 7992.—For manufacturer of machine of the type of a general joiner to make tenon and cut moldings, and with a band saw combined; a general purpose machine for hand power.

Inquiry No. 7993.—For manufacturers of lightest, strongest material for airship cages carrying motor and load.

NEW BOOKS, ETC.

PERPETUAL ECCLESIASTICAL CALENDAR. Showing the Dates of the Principal Feasts of the Church's Year. By Clarence E. Woodman, Ph.D., Knight of the Royal Order of Isabella the Catholic. New York: The Columbus Press, 1905. Price, 25 cents.

This pamphlet shows by simple inspection of tables the dates of the principal feasts of the Church's year from the beginning of the Christian era to the year 4499, with rules for unlimited extensions. It is an excellent example of the practical use of mathematics.

ART OF TYPEWRITING. Being Practical Instruction with Graduated Exercises and Model Examples Suited to Any Machine and Including a Method or of "Touch" Writing. By George Carl Mares. London: Guilbert Pitman, 1905. 18mo.; pp. 182. Price, $1.

The typewriter stands pre-eminent among the devices evolved for relieving the strain upon the time and labor of those engaged in the world's commerce. The typewriter, being as it were an antidote to the feverishness of life, and serving as a tonic to the busy man, may be aptly regarded as a restorative. To get the best results from any medical preparation it is desirable that its constituent parts should be known, that the manner of taking it, and how best to nourish its action, should be studied. Treating business life as an ailment, and the typewriter as a specific, the author brings forward this extremely useful book.

INDEX OF INVENTIONS

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AND EACH BEARING THAT DATE

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Fence post, J. A. Blake	815,788
Fender carrier, B. Lev	15,925
Fiber crating machine, A. M. Sheakley	815,478
Fibers, preparing, B. S. Summers	815,876
File for bills, receipts, and the like, bill, E. L. Henderson	815,427
Filing case, E. E. Illig	815,535
Filter, G. W. Gesner	815,417
Filtering Material, Loffler & Weidle	815,846
Filtering streams and the like, means for, T. Lydon	815,722
Fine fuel furnace, F. N. Spear	815,562
Fire escape, J. A. Breckon	815,401
Fire pot and twyer iron, combined, C. O. Swenson	815,489
Fireproof window, automatic, E. T. Wilkinson	815,772

Flour can and flour holder, dustless, W. G. Gadue, reissue	12,464
Fluid pressure system, F. E. Case	815,903
Folding box, M. Hirsch	815,704
Folding chair, W. A. Bradley	815,507
Fourchette, H. Texier	815,878
Fruit-picker, C. L. Uthus	815,660
Fuel economizer, W. E. Cole	815,512
Fuel feeding device, L. K. Davis	815,686
Furnaces, pulverized fuel burner for, C. A. Matcham	815,929
Fuse clamping terminal, A. C. Savage	815,746
Gage, A. Holt	815,829
Garbage can, sanitary, G. Wangenheim	815,496
Garment, L. Reed	815,933
Garment supporter, D. H. Crosser	815,906
Gas and separating its elements, apparatus for liquefying, C. Linde	815,544
Gas burner, P. Keller	815,536
Gas generator, acetylene, E. M. Rosenbluth	815,745
Gas lighting burner, incandescent, D. Anderson	815,777
Gas, oil, water, and sand separator, A. S. Cooper	815,407
Gas producer, A. Cerasoli	815,794
Gas producer, C. Ellis	815,913
Gas purifier, Q. Bent	815,674
Gas-purifying apparatus, A. M. Gow	815,812
Gear, reversing, T. H. Butler	815,331
Gearing, change speed, Soller & Hottinger.	815,386
Grain cleaning and separating machine, P. Moon	815,457
Grate, R. A. May	815,450
Gravity bolt and fusible connection for metallic frames and windows therefor, A. H. Woodruff	815,774
Grease cup, T. E. Peters	815,734
Grinding machine, A. C. Calkins	815,333
Grip device, intermittent, E. H. Ahlander.	815,895
Gripping tool, adjustable, W. Punt	815,376
Gun, ballistic, F. I. Du Pont	815,468
Gun, electrical, M. E. Thomas	815,490
Gun lock, T. M. Thorsen	815,879
Hame clip, adjustable, F. E. Vorce	815,767
Hammer, A. M. Layton	815,442
Harrow, J. C. & F. G. Agey	815,894
Harrow riding attachment, S. R. Hill	815,531
Harvester, beet, J. W. Arthur	815,325
Harvester, corn, M. D. Hatch	815,530
Harvester topping attachment, L. J. Knox.	815,437
Harvesting machine, pea, W. A. Johnson.	815,711
Hat guard, C. E. Keator	815,714
Hat holder, Adams & Clark	815,893
Heater, E. E. Gold	815,695
Heating apparatus, Jones & Johnson	815,839
Heating systems, automatic steam and water trap for steam, T. F. Dexter	815,335
High potential switch or circuit breaker, E. M. Hewlett	815,824
Hoisting and conveying apparatus, C. J. Horgen	815,706
Hoisting apparatus, R. H. Krueger	815,440
Hoisting bucket, Hetzel & Waechter	815,823
Hoops and securing the ends thereof, machine for sizing barrel, J. G. Iverson	815,835
Horn support, A. S. Marten	815,448
Horseshoe, A. Anderson	815,399
Hose coupling, A. Schaffer	815,476
Hose coupling, S. Oldham	815,627
Hot blast apparatus, J. Fallek	815,915
Incubator alarm, F. T. Porter	815,557
Induction machines, excitation for, M. Leblanc	815,357
Induction machines, system of excitation for, M. Leblanc	815,356
Inhaler, R. C. Coburn	815,510
Insulator, G. L. Ricks	815,471
Insulator, H. S. Blynt	815,506
Insulator for electric apparatus, G. W. Gesner	815,418
Internal combustion engine, F. M. Uhler.	815,492
Internal combustion engine, De Dion & Bouton	815,802
Ironing table, T. L. Nelms	815,465
Journal bearing, C. V. Randolph	815,469
Kiln. See Cement kiln.	
Kiln, R. W. Stewart 815,387,	815,388
Knitting machine, lamb, H. Stoll, Jr	815,760
Knockdown box, J. Adams	815,670
Ladder, combination step and extension, P. C. Plaster	815,736
Lamp, alcohol, A. A. Warner	815,884
Lamp rheostat, T. J. Bull	815,330
Lamp support, adjustable, J. H. Stevenson	815,563
Lamps, electrical connector for electric, E. A. Lowe	815,605
Latch, A. B. Vanes	815,493
Latch, J. W. Pettijohn	815,553
Lathe, Pealing & Harrison	815,733
Lathe driver, D. H. Teas	815,659
Lawn sprinkler, O. P. Waggener	815,495
Leather and the like, implement for cutting, E. R. Shaw	815,643
Level surfacing machine, R. McCoy	815,460
Life preserver, M. Wikstrom	815,394
Lifting heavy metallic plates, device for, M. Maynard	815,452
Light-beams, apparatus for observing the oscillations of, A. W. Hornauer	815,831
Liquid trap, A. Goldfein	815,420
Loom for weaving pile fabrics, Gray & McKenzie	815,526
Loom for weaving tubular fabrics, G. A. Pickup	815,555
Looms, thread parting mechanism for, O. Benson	815,786
Luminous areas, device for comparing, W. D. Ryan	815,865
Mail-box, W. E. & G. Weston	815,770
Mail box, rural, C. F. Farrar	815,585
Mangle, G. Hatch	815,820
Match box, self striking, M. Larsen	815,596
Mattress, F. Martin	815,610
Measuring, counting, and cutting off fabric, machine for, W. C. Perry	815,861
Measuring instrument, E. W. Campagna	815,509
Mechanical lubricator, M. Briet	815,508
Metallic tie, B. A. Legg	815,718
Milking shield, J. W. Hughes	815,429
Millinery box, C. A. Leyh	815,543
Molding press, hydraulic, P. Bonvillain	815,577
Monkey wrench, A. T. Martin	815,449
Mop, J. F. Doebler, Jr	815,336
Mop wringer, S. Krainik	815,539
Motor, F. E. Lewis	815,444
Mowing machine, R. G. Coates	815,681
Music leaf turner, T. Steventon	815,873
Musical instrument, E. V. Molen	815,854
Musical transposition chart, R. C. Burton.	815,403
Nipple for nursing bottles, M. E. Knauff.	815,435
Nitrogen producing apparatus, pure, C. Linde	815,601
Nut lock, H. P. Watson	815,497
Nut lock, J. E. Glenn	815,524
Nut lock, F. T. Leatherman	815,541
Ore washing machine, A. S. Mitchell	815,853
Ores, reduction of, C. P. Townsend	815,881
Ores, treating nickel, C. Langer	815,717
Oscillating engine, J. L. Pilling	815,632
Packet holder, F. E. Blacker	815,505
Packing, water tube boiler, Miller & Kronier	815,930
Paddle wheel, feathering, E. A. Young	815,776
Panorama sight, A. Swasey	815,657
Paper box making machine, A. Oesterreich.	815,626
Paper boxes, manufacture of, A. Oesterreich	815,858
Paper clip, H. E. Hawkins	815,348
Paper, magazine for holding toilet, L. T. Ellis	815,337
Paper making machines for the manufacture of one side colored, clouded-colored, and marbled papers, apparatus for supplying coloring material in, C. Tittel	815,763
Paste board bending machine, I. L. Sheldon	815,479
Pellet coating machine, J. Mangin	815,608
Pen, fountain, W. C. Luther	815,721
Pencil holder, E. M. Cyphers	815,515
Photographic shutter, H. B. Perry	815,552
Photometer, flicker, J. T. Dempster	815,800
Piano players, detachable key-changer for pneumatic, E. E. Flora	815,412
Pie making machine conveyer, J. C. Hutchison	815,707
Pipe, cigar, or cigarette holder, B. A. Levett	815,443
Pipe union, M. Dean	815,581
Pipe wrench, F. Fisher	815,694
Planter, Brimmon & Nelson	815,328
Planter, O. Phillips	815,554
Planter, P. C. White	815,771

Planter, corn, A. C. Lindgren	815,603
Planter, seed, J. L. Floyd	815,413
Plaster supporting slab, F. A. Seifert	815,751
Plastic material, machine for making continuously formed articles from, J. K. Williams	815,571
Plastics, affixing, E. J. Winslow	815,886
Plow attachment, Landis & Myers	815,441
Plumb, level, and inclinometer, W. A. Dimick	815,690
Pneumatic tired wheel, T. B. Jeffery	815,430
Precious metals from zinc ores, extraction of, A. R. Meyer	815,614
Precious metals, refining hydrometallurgical products containing, C. W. Merrill	815,851
Printer and stencil cutter, sign, D. Gerner	815,808
Printing block adjusting device, W. H. Waldron	815,662
Printing machine, T. M. North	815,857
Printing press ink distributing device, R. Marx	815,850
Propeller, boat, H. B. Prosser	815,738
Propeller, screw, E. K. Purvis	815,740
Pulley device, G. Merritt	815,613
Pulp screening machine, E. W. Goodrick	815,421
Pump, ammonia, A. H. Eddy	815,911
Pump and motor, rotary, E. M. Fraser	815,522
Pump, centrifugal, F. W. & C. A. Krogh	815,439
Pump, centrifugal, F. W. Krogh	815,540
Punching bag apparatus, W. J. Bryon, Jr.	815,667
Putting mat, E. Smith	815,649
Radiator, W. R. Kinnear	815,354
Rail anchor, J. M. Scott	815,383
Rail joint, N. Sumic	815,762
Rail straightening and leveling device, H. M. Stark	815,757
Rail tie, F. N. Mihills	815,364
Railway and tramway rail, S. W. Dalzell.	815,580
Railway, elevated, W. M. Reed	815,377
Railway frog, J. E. Lewis	815,719
Railway spike, D. L. Vaughan	815,766
Railway switch, automatic, U. A. Woodbury 815,887,	815,888
Railway switch mechanism, F. K. Hoffman	815,533
Railway tie plate, W. B. Johnson	815,590
Railway track machine, Mickey & Caldwell	815,727
Railway track structure, G. Shoemaker	815,869
Razor, G. W. Korn	815,355
Regulator. See Beam tension regulator.	
Regulator, A. W. Francis	815,806
Relay, R. Herman	815,822
Reservoir retaining wall, L. K. Davis	815,687
Retinoscope, A. L. Palis	815,859
Retort charging apparatus, E. Korting	815,438
Revolver stock, detachable, D. B. Martin.	815,609
Rheostat for starting and controlling electric motors, W. J. Day	815,908
Riding gallery, J. W. Armitage	815,503
Ringing and listening key, automatic, A. Carliss	815,405
Rock drill shaping and swaging mechanism, W. P. Lightbody 815,844,	815,845
Rotary engine, N. R. Smith	815,482
Rule, open double plumb, A. Vreeland	815,570
Sack cleaning machine, F. J. Wolff	815,396
Sad iron, J. L. Poalk	815,634
Saddle, harness, J. W. Gardner	815,917
Saddle post, W. G. Schaeffer	815,475
Sash cord fastener, H. Hansen	815,587
Sash fastener, C. H. Snearer	815,483
Sash fastener, A. Kissinger	815,537
Sash lock, W. A. Douglas	815,803
Sash, sheet metal window, J. W. Watkins	815,769
Sash ventilator, window, F. L. Hargreaves.	815,818
Saw, hack, W. E. Lawrence	815,597
Saw holding apparatus, J. McLean	815,462
Sawmill set works, T. S. Wilkin	815,665
Scale, computing, J. W. Culmer	815,684
Scale, weighing, P. Frost	815,414
Screw driver, screw holding, L. S. Starrett	815,758
Scrubber, G. H. Garnet	815,343
Scrubbing device, H. E. H. Armann	815,324
Seal, bottle, G. H. Gillette	815,344
Sealing and stamping machine, envelop, Vanness & O'Brian	815,494
Sealing device, bottle, Cardell & Bergstrom	815,902
Secondary battery, E. L. Oppermann	815,628
Seeding machine, roller, J. T. Mayhew	815,451
Separating device, D. K. Swartwout	815,656
Sewing machine buttonhole cutting device, E. B. Allen	815,501
Sewing machine guide, B. Fleigel	815,342
Sewing machine thread case, P. Diehl	815,517
Sewing machine trimmer and binder, J. Higgins	815,428
Shade fixture, window, J. M. Murdock	815,621
Shade holder, Marten & Eichhorn	815,545
Shaft, flexible, C. F. C. Mehlig	815,726
Shaft, jointed, J. K. Stewart	815,485
Sharpening mechanism, rock drill, W. P. Lightbody 815,720,	815,843
Shifting device, E. C. Smith	815,650
Shoe polishing outfit, G. H. Rogers	815,934
Shoe rack covering, P. J. Porter	815,932
Shredder feeder, G. W. Crane	815,408
Shutter fastener, J. T. Johnson	815,589
Shutters, swivel for window blind, B. H. Phillipps	815,862
Sifter, flour, W. G. Gadue	815,415
Signal box or package, J. W. Becherer	815,783
Signaling system, electric, S. M. Young 815,890,	815,891
Skid, J. C. Marks	815,848
Skirt marker, Mohr & Cooper	815,455
Skirt support and lifter, T. Schollhorn	815,749
Skiving machine, L. P. Hawkins	815,702
Smoke consumer, J. Wilson	815,574
Sole cutting machines, knife carrying mechanism for, A. M. Stickney	815,486
Speed changer, W. T. Sears	815,642
Speed indicator, G. Ihle	815,708
Speed indicator, electrical, R. Anderson	815,778
Speed varying mechanism, G. A. Gulowsen.	815,345
Spike puller, T. W. Harber	815,701
Spindle. See Spinning spindle.	
Spinning spindle, R. Morris	815,367
Spinning yarn from flax, cotton, etc., A. McMeekin	815,623
Spiral separator, F. Nichter	815,856
Spool, compensating, F. E. Cole	815,511
Spraying device, H. L. Joslin	815,713
Spring edge supporting hook, Knorzer & Danner	815,436
Square and bevel, combined, A. Haag	815,528
Square, try, J. A. Traut	815,389
Stair, J. M. Knaus	815,840
Stamping machine, I. Eyer	815,805
Staples, etc., holder for, J. A. Blake	815,787
Starch, etc., apparatus for drying, E. E. Perkins	815,373
Static discharger and lightning arrester, H. M. Shaw	815,384
Stationary switch and adjustable car wheel for use thereon, A. T. Winchell	815,666
Stave jointer, L. F. Dieter	815,518
Steam chests, heat screen for, D. C. Bailly	815,780
Sill, glycerin, C. Sudre	815,761
Stilt, H. J. Chambers	815,795
Stock loader, E. Arthur	815,898
Stone molding machine, artificial, N. F. Palmer	815,372
Stool and pail holder, foldable milking, J. E. Beebe	815,672
Stool, milking, M. T. Hamilton	815,425
Stopper, W. I. Kaiser	815,351
Stove grate, J. Loftus	815,445
Stoves, sealed magazine for, S. C. Laitner.	815,716
Strainer, M. Stransky	815,874
Stropping machine, J. R. Curley	815,685
Stump puller, Fuller & Bateman	815,586
Sucker rod elevators, hook for, J. Mahoney	815,723
Sulky, H. J. Miller 815,615,	815,616
Sulky seat, C. C. Lapham	815,841
Supporter, S. Lipkowits	815,604
Suspension device, adjustable, F. L. Gregory	815,422
Switch, E. Fields	815,693
Telegraph key, J. J. Ghegan	815,809
Telephone attachment, J. Silverman 815,752,	815,753
Telephone transmitter, E. E. Yaxley	815,889
Telephonic apparatus, J. G. Roberts	815,380
Telescopic elevator, J. Kovacevic	815,594
Tent, window, W. B. McLaughlin	815,622
Theater curtains, means for hanging and operating, J. H. Channon	815,904
Thermal protectors, automatic electrical self soldering reset for, F. B. Cook	815,406
Tire, cushion, F. G. Freese	815,523
Tire, pneumatic, R. A. Harris	815,346
Tire shrinking machine, D. O. Brackett	815,900
Tire, vehicle, J. K. Williams	815,572

Tobacco press, F. A. Bonroe 815,790
Tool, combination, P. L. Robertson 815,381
Tool, combination, F. E. Foor 815,916
Tooth mold, E. Pierrepont 815,374
Toothpick and forming same, H. S. Hopper 815,534
Top, spinning, E. T. Jones 815,591
Torpedo conveying and launching apparatus, T. H. Wheless 815,393
Toy, Z. A. Curtis 815,410
Toy, W. D. Winger 815,667
Toy car, F. V. Bartlett 815,504
Trace holder, Gruwell & Wiebke 815,423
Traction wheel, E. F. Piper 815,633
Train control system, G. H. Hill 815,826
Train order holding device, A. E. Willliams 815,500
Train stopping means, E. Renaud 815,637
Transformer, W. S. Moody 815,729
Transformer, electric, M. O. Troy 815,765
Transformer for cautery and diagnostic work, variable voltage electric, E. H. Rollinson 815,863
Trap. See Animal trap.
Tree-digger, nursery, D. Feigly 815,901
Trolley contact device for operating electric signals, automatic overhead, B. D. Whitcomb 815,499
Trousers, M. J. Leiberman 815,598
Truck, elevating, S. A. Garland 815,416
Truck, railway car, S. A. Bemis 815,784
Truss, A. C. Cooke 815,682
Tubular articles, machine for shaping, N. Marshall 815,362
Tug or support, shaft, J. O'Connell 815,730
Turbine governing mechanism, R. H. Rice, ... 815,742, 815,743
Turbine governing mechanism, D. Hurley .. 815,833
Turning and boring articles, such as spools, etc., machine for, H. K. Stockwell ... 815,567
Type writers, adjustable line predetermining device for, C. A. Shea 815,644
Typewriting machine, J. Felbel 815,339, 815,340
Typewriting machine, B. C. Stickney 815,565
Typewriting machine, E. F. Kunath 815,595
Typewriting machine adding device, C. R. Martineau 815,724
Umbrella, E. W. Crane 815,797
Valve, air brake, W. O. Gunckel 815,816
Valve, expansion, A. H. Eddy 815,912
Valve for air compressors, T. E. Sturtevant 815,488
Valve gear for explosion engines, L. P. A. A. Bailleul 815,779
Valve, steam engine, D. J. Hoisington 815,828
Vehicle draft connection, A. T. Stutson ... 815,655
Vehicle frame, motor propelled, G. H. Jones 815,918
Vehicle running gear, J. H. Gressom 815,527
Vehicle wheel, C. C. Wilson 815,573
Vehicle wheel, R. F. Martindale 815,611
Vending machine, J. E. Packard 815,731
Vending machine, F. W. Tucker 815,882
Ventilator, M. Kinzey 815,434
Vessel, navigable, J. P. Pool 815,635, 815,737
Vibrator controlling means, W. F. Molt ... 815,728
Violin tailpiece, B. Cather 815,793
Wagon brake, J. L. Thomas 815,568
Wall and ceiling covering, removable, J. O. Parkinson 815,550
Wall covering, H. L. Messmore 815,547
Wall or the like, retaining, E. M. Scofield. 815,866
Wall, portable, H. B. Copeland 815,513
Warp stop motion, electrical, Boardman & Sharples 815,789
Washtub, M. Robin 815,472
Water bag or bottle, T. W. Miller 815,366
Weather strip, M. M. Shellaberger 815,646
Well rig, oil, Emerson & Kerstetter 815,519
Wheel, H. L. Ferris 815,520
Winding mechanism, Fettback & Lieckfeld 815,692
Window and door screen, H. E. Southworth. 815,484
Window cleaner, H. Beatty 815,782
Window dressing apparatus, F. Conhaim ... 815,796
Window lifter, N. R. Evans 815,914
Window lock and gravity bolt, A. H. Woodruff 815,669
Wire clamp, D. C. Smith 815,871
Wire splicer, D. C. Smith 815,754, 815,755
Wood, preserving, J. B. Card 815,404
Wrench, W. C. Lott 815,446
Wrench, J. A. Smith 815,872
Yoke, cultivator, A. C. Lindgren 815,602
Zinc sulfate solution into zinc oxid, apparatus for converting, C. E. Dewey 815,516

DESIGNS.

Bottle, A. Andresen 37,906
Button, lapel, E. Gebhardt 37,899
Carpet, A. M. Rose 37,910
Carpet, W. L. Jacobs 37,911
Carpet, J. S. McNab 37,912, 37,913
Condiment container, F. E. Burley 37,901
Curtain, E. F. Boubel 37,909
Grape fruit holder, F. E. Burley 37,905
Mug, wooden, R. P. Spooner 37,902
Plate, E. J. Owen 37,903
Plate or similar dish, A. S. Higgins 37,904
Silverware mount, E. Meyers 37,900
Stove, cooking, E. C. Cole 37,908
Water receptacle or bottle, I. Newell 37,907

TRADE MARKS.

Ale, S. Boltons Sons 50,523
Antipyretics, Ammo Phenin Chemical Co 50,533
Antiseptic refrigerants for wounds, G. H. Tichenor 50,560
Antiseptics, Lloyd Bros. 50,515
Antiseptics or germicides, Lloyd Bros 50,519
Axes, hatchets, and adzes, Collins Co 50,481
Baking powder, bicarbonate of soda, and cream of tartar, A. Schilling & Co 50,478
Banjo heads and drum heads, Duplex Manufacturing Co. 50,540
Binders, loose leaf, Sieber & Trussell Mfg. Co. 50,577
Boiler tube cleaners or scrapers, A. W. Chesterton & Co. 50,459
Boots and shoes made of leather, M. A. Packard Co. 50,551
Boots, shoes, and slippers, leather, Rindge Kalmbach Logie & Co 50,522
Brandy, apricot, Nuyens & Cie 50,554
Brushes, tooth, C. Loonen 50,470
Butter, Fox River Butter Co 50,483
Butter, J. P. Baden Produce Co 50,485
Candies, certain, George Ziegler Co 50,441
Candles, short thick, Clarke's Pyramid and Fairy Light Co. ....50,498 to 50,500
Canned fruits and vegetables, Gibbs Preserving Co. of Baltimore City 50,442
Canned sardines, William Underwood Co 50,494
Car couplings, car buffers, and draft gears and parts thereof, Gould Coupler Co 50,443
Cigars, A. Siegel 50,449
Cleaning enameled and porcelain ware, preparations for, W. C. McKinney 50,471
Cleaning precious metals, powdered preparation for, J. B. Haldeman 50,465
Coal, bituminous, War Eagle Fuel Co 50,567
Coal, bituminous and anthracite, Economy Fuel Co. 50,504, 50,505
Coffee, Arbuckle Bros. 50,439
Coffee, New Orleans Coffee Co 50,446
Coffee, Arbuckle Bros 50,455
Coffee, A. Schilling & Co 50,477
Coffee berry, either whole or ground, Milliken, Tomlinson Co. 50,473
Coffee grinders, National Specialty Mfg. Co. 50,474
Coffee, roasted, Fort Smith Commission Co.. 50,464
Cornmeal, Gulfport Grocery Co 50,444
Cornmeal, Threefoot Bros. & Co 50,454
Cornmeal, both bolted and granulated, Diamond Elevator & Milling Co 50,482
Corset bones or stays, J. Janowitz 50,514
Cotton duck, Hogansville Mfg. Co 50,546
Cotton piece goods, Gilbert Mfg. Co 50,544
Cough Cure, Kickapoo Indian Medicine Co.. 50,565
Cough drops, Davies, Rose & Co 50,571
Cranberries, J. J. White 50,493
Cream separators, centrifugal, American Separator Co. 50,438
Dental chairs, Ritter Dental Mfg. Co. 50,556, 50,557
Dyestuff, Cassella Color Co. 50,497
Eggs, hens', G. M. Wattles & Son 50,491
Electric conduit fittings, Crouse-Hinds Co... .... 50,462, 50,463
Engines, gas and gasolene, Otto Gas Engine Works 50,486
Escharotics, Lloyd Brothers 50,516
Fabrics, textile, Eddystone Mfg. Co. .... 50,561 to 50,563, 50,578

Fertilizers, Independent Packers Fertilizer Co. 50,484
Files and rasps, Carver File Co.......... 50,538
Flavoring extracts, Joseph Burrnett Co.... 50,469
Flour, wheat, Pittsburg Milling Co.......... 50,476
Flour, wheat, Burrus Mill & Elevator Co... 50,479
Flour, wheat, Coles Co. 50,480
Food, stock, M. W. Savage.......... 50,447
Germicides Rhuma-Sulphur Co.......... 50,531
Glass, cut and engraved, T. G. Hawkes & Co. 50,559
Grease cups, Lunkenheimer Co. 50,453
Hair restorers, B. T. Goldman.......... 50,573
Harvesters and extra and repair parts and pieces therefor, International Harvester Co. of America 50,467
Harvesters and repair parts and pieces therefor, International Harvester Co. of America 50,468
Hats, Gage Bros. & Co. 50,508
Ice cream and ices, powder for use in making, W. A. Collins.......... 50,569
Insoles, Electric Appliance Co.......... 50,506
Instep supporter or arch prop, George G. London Mfg. Co. 50,564
Lamps and generators, acetylene, A. H. Funke 50,572
Liniment, Dr. Peter Fahrney & Sons Co.... 50,526
Linings, dress, M. W. Burd.......... 50,537
Lotion used in the treatment of hernia, J. Fandrey 50,541
Lozenges, New England Confectionery Co... 50,475
Lubricating grease, Beerwald & Levin...... 50,456
Measuring the capacity of the lungs, instrument for, C. H. Bird.......... 50,457
Medical compound, M. M. Foy.......... 50,543
Medicinal and toilet oil for skin diseases, Illinois Laboratories 50,529
Medicinal preparation for the cure of rheumatism, L. Adler 50,532
Medicinal soap, Barclay & Barclay..50,534, 50,535
Medicine for certain named diseases, Paul Bros. Medicine Co. 50,576
Medicines, certain named, H. O. Hurley... 50,548
Metals, antifriction, Merchant & Evans Co. 50,472
Microbe killer, I. Radam.......... 50,521
Molasses, N. W. Taussig Co.......... 50,445
Mucilage, paste, and adhesive cements, Carter's Ink Co. 50,451
Nails, horse, Capewell Horse Nail Co....... 50,450
Nerve elixir, E. Dort.......... 50,502
Oil, castor, National Lead Co. 50,553
Oils and grease, lubricating, F. B. Hower... 50,466
Paints, Toch Brothers 50,490
Paper, writing, L. A. Lehmaier.......... 50,550
Periodical, magazine, Advance Publishing Co. 50,568
Pharmaceutical preparation, Lloyd Bros.... .... 50,517, 50,518
Pins, earrings, and studs, Donley & Co..... 50,501
Pistols, Colt's Patent Fire Arms Mfg. Co.. 50,460
Preparations for diseases of the stomach and bowels, Dr. Peter Fahrney & Sons Co.. 50,527
Remedies for pulmonary diseases, Fischer Chemical Importing Co. 50,542
Remedy, headache, Lewis Pharmacal Co.... 50,575
Respirators, H. S. Cover.......... 50,461
Scarfs, W. Trevor.......... 50,579
Scissors, C. F. Boker.......... 50,458
Seeds, garden, flower, and field, Livingston Seed Co. 50,530
Sheetings and drillings, Grendel Mills....... 50,511
Sheetings and drills, cotton, K. Iwahara 50,549, 50,574
Shirts for men and women, outing, Guiterman Bros. 50,512
Shoes, tennis, Hood Rubber Co.......... 50,547
Soap, Summit City Soap Works.......... 50,487
Soap, Dunwoody Bros. Soap Co.......... 50,503
Soap, Summit City Soap Works.......... 50,566
Soap, borax, Pacific Coast Borax Co....... 50,555
Soap, toilet, D. R. Bradley & Son.......... 50,536
Soda water syrup and a drink made from such syrup, Wiley Mfg. Co.......... 50,489
Spices, A. Schilling & Co.......... 50,448
Spices, ground, Citizens' Wholesale Supply Co. 50,452
Stockings, Columbia Hosiery Co. 50,570
Stove polish, powdered, X-Ray Stove Polish Co. 50,495
Tea and coffee pots and coffee urns, Silver & Co. 50,525
Tonic beverages and extracts for making the same, Wharton Chemical Co.......... 50,492
Undershirts and drawers for men and women, Heilmann, Loth & Gutman...... 50,513
Washing powder, Summit City Soap Works. 50,488
Watches, watch cases, and watch movements, D. Gruen & Sons.......... 50,545
Wax, J. E. Chandler.......... 50,440
Whisky, Brede-Lang Co. 50,496
Whisky, P. Freiler 50,507
Whisky, D. Green 50,510
Whisky, H. R. Myers 50,520
Whisky, Shortell & Timmins.......... 50,524
Whisky, Hoffheimer Bros. Co.......... 50,528
Whisky, Dallemand & Co.......... 50,539
Whisky, A. Myers 50,552
Whisky, Straus Bros. Co. 50,558
Whisky, rye, Gilliams, Jones & Co. 50,509

LABELS

"Big Two, or The Great Western Cholera and Cramp Cure," for medicine, T. H. Le Dane 12,717
"Cupidine," for a lotion, C. R. Wilson.... 12,713
"Garrison's Croup Salve," for salve, J. Garrison 12,716
"Lady Alice," for perfumery, Jennings Mfg. Co. 12,715
"Red Seal," for beer, St. Louis Brewing Association 12,719
"Red Star," for massage cream, Red Star Massage Cream Co. 12,714
"Robt. Hamilton Old Tom Gin," for gin, D. Holzman & Co. 12,720
"The Compactum Handkerchief," for handkerchiefs, Acheson Harden Co. 12,725
"The Hibernia," for handkerchiefs, Acheson Harden Co. 12,722
"The New Chemical Felt," for a felt for polishing gold and silver, M. C. Pritchard 12,726
"The New Linene Handkerchiefs," for handkerchiefs, Acheson Harden Co.......... 12,724
"The Old Time Irish Linen Hdkfs.," for handkerchiefs, Acheson Harden Co..... 12,723
"Van Emden Ground Chocolate," for chocolate, Van Emden Cocoa Co.......... 12,721
"Wavenlock," for hair tonic, F. H. McGuire 12,712
"Words are Flowers Fruits are Facts Texas Post Oak," for medicine, J. Mack Mahon 12,718

PRINTS.

"Adlers Young Men's Summer Styles," for men's summer apparel, David Adler & Sons Clothing Co. 1,599
"Belding's Yardwide Guaranteed Satin," for satins, Belding Bros. & Co.......... 1,598
"Chief Kokomo," for rubber tires, Kokomo Rubber Co. 1,603
"Design for Card Box," for playing cards, Willis W. Russell Card Co.......... 1,602
"Imperial Hat Ads 1906," for hats, Samuel Mundheim Co. 1,597
"(Next Morning.) Bromo-Seltzer," for bromo seltzer, Emerson Drug Co.......... 1,601
"Oldsmobile Model B—Straight Dash," for an automobile, Shaw-Torrey Co.......... 1,604
"Oldsmobile Model L," for an automobile, Shaw-Torrey Co. 1,605
"Oldsmobile Model S," for automobiles, Shaw-Torrey Co. 1,606
"Uncle John," for confectionery, D. Auerbach & Sons 1,600

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., 361 Broadway, New York.